Gas Volume	Calibration Concentration
10 µL	1 µg/L
20 µL	2 µg/L
50 µL	5 µg/L
100 µL	10 µg/L
250 µL	25 µg/L

5.8 Secondary dilution standards - Using stock standard solutions, prepare in methanol, secondary dilution standards containing the compounds of interest, either singly or mixed together. Secondary dilution standards must be stored with minimal headspace and should be checked frequently for signs of degradation or evaporation, especially just prior to preparing calibration standards from them. Store in a vial with no headspace for one week only.

5.9 Surrogate standards - The surrogates recommended are toluene-d_8, 4-bromofluorobenzene, and dibromofluoromethane. Other compounds may be used as surrogates, depending upon the analysis requirements. A stock surrogate solution in methanol should be prepared as described above, and a surrogate standard spiking solution should be prepared from the stock at a concentration of 50-250 µg/10 mL in methanol. Each water sample undergoing GC/MS analysis must be spiked with 10 µL of the surrogate spiking solution prior to analysis.

5.9.1 If a more sensitive mass spectrometer is employed to achieve lower detection levels, more dilute surrogate solutions may be required.

5.10 Internal standards - The recommended internal standards are fluorobenzene, chlorobenzene-d_5, and 1,4-dichlorobenzene-d_4. Other compounds may be used as internal standards as long as they have retention times similar to the compounds being detected by GC/MS. Prepare internal standard stock and secondary dilution standards in methanol using the procedures described in Sections 5.7 and 5.8. It is recommended that the secondary dilution standard should be prepared at a concentration of 25 mg/L of each internal standard compound. Addition of 10 µL of this standard to 5.0 mL of sample or calibration standard would be the equivalent of 50 µg/L.

5.10.1 If a more sensitive mass spectrometer is employed to achieve lower detection levels, more dilute internal standard solutions may be required. Area counts of the internal standard peaks should be between 50-200% of the area of the target analytes in the mid-point calibration analysis.

5.11 4-Bromofluorobenzene (BFB) standard - A standard solution containing 25 ng/µL of BFB in methanol should be prepared.

5.11.1 If a more sensitive mass spectrometer is employed to achieve lower detection levels, a more dilute BFB standard solution may be required.

5.12 Calibration standards - Calibration standards at a minimum of five concentrations should be prepared from the secondary dilution of stock standards (see Sections 5.7 and 5.8). Prepare these solutions in organic-free reagent water. One of the concentrations should be at a concentration near, but above, the method detection limit. The remaining concentrations should correspond to

the expected range of concentrations found in real samples but should not exceed the working range of the GC/MS system. Each standard should contain each analyte for detection by this method (e.g. some or all of the compounds listed in Table 1 may be included). Calibration standards must be prepared daily.

5.13 Matrix spiking standards - Matrix spiking standards should be prepared from volatile organic compounds which will be representative of the compounds being investigated. At a minimum, the matrix spike should include 1,1-dichloroethene, trichloroethene, chlorobenzene, toluene, and benzene. It is desirable to perform a matrix spike using compounds found in samples. Some permits may require spiking specific compounds of interest, especially if they are polar and would not be represented by the above listed compounds. The standard should be prepared in methanol, with each compound present at a concentration of 250 µg/10.0 mL.

5.13.1 If a more sensitive mass spectrometer is employed to achieve lower detection levels, more dilute matrix spiking solutions may be required.

5.14 Great care must be taken to maintain the integrity of all standard solutions. It is recommended all standards in methanol be stored at -10°C to -20°C in amber bottles with Teflon lined screw-caps.

6.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

6.1 See the introductory material to this chapter, Organic Analytes, Section 4.1.

7.0 PROCEDURE

7.1 Three alternate methods are provided for sample introduction. All internal standards, surrogates, and matrix spikes (when applicable) must be added to samples before introduction.

7.1.1 Direct injection - in very limited application, (e.g., volatiles in waste oil or aqueous process wastes) direct injection of aqueous samples or samples diluted according to Method 3585 may be appropriate. Direct injection has been used for the analysis of volatiles in waste oil (diluted 1:1 with hexadecane) and for determining if the sample is ignitable (aqueous injection, Methods 1010 or 1020). Direct injection is only permitted for the determination of volatiles at the TCLP regulatory limits, at concentrations in excess of 10,000 µg/L, or for water-soluble compounds that do not purge.

7.1.2 Purge-and-trap for aqueous samples, see Method 5030 for details.

7.1.3 Purge-and-trap for solid samples, see Method 5030 for details.

7.2 Chromatographic conditions

7.2.1 General:

Injector temperature:	200-225°C
Transfer line temperature:	250-300°C

7.2.2 Column 1 (A sample chromatogram is presented in Figure 5)

Carrier gas (He) flow rate:	15 mL/min
Initial temperature:	10°C, hold for 5 minutes
Temperature program:	6°C/min to 160°C
Final temperature:	160°C, hold until all expected compounds have eluted.

7.2.3 Column 2, Cryogenic cooling (A sample chromatogram is presented in Figure 6)

Carrier gas (He) flow rate:	15 mL/min
Initial temperature:	10°C, hold for 5 minutes
Temperature program:	6°C/min to 160°C
Final temperature:	160°C, hold until all expected compounds have eluted.

7.2.4 Column 2, Non-cryogenic cooling (A sample chromatogram is presented in Figure 7). It is recommended that carrier gas flow and split and make-up gases be set using performance of standards as guidance. Set the carrier gas head pressure to * 10 psi and the split to * 30 mL/min. Optimize the make-up gas flow for the separator (approximately 30 mL/min) by injecting BFB, and determining the optimum response when varying the make-up gas. This will require several injections of BFB. Next, make several injections of the volatile working standard with all analytes of interest. Adjust the carrier and split to provide optimum chromatography and response. This is an especially critical adjustment for the volatile gas analytes. The head pressure should optimize between 8-12 psi and the split between 20-60 mL/min. The use of the splitter is important to minimize the effect of water on analyte response, to allow the use of a larger volume of helium during trap desorption, and to slow column flow.

Initial temperature:	45°C, hold for 2 minutes
Temperature program:	8°C/min to 200°C
Final temperature:	200°C, hold for 6 minutes.

A trap preheated to 150°C prior to trap desorption is required to provide adequate chromatography of the gas analytes.

7.2.5 Column 3 (A sample chromatogram is presented in Figure 8)

Carrier gas (He) flow rate:	4 mL/min
Initial temperature:	10°C, hold for 5 minutes
Temperature program:	6°C/min to 70°C, then 15°C/min to 145°C
Final temperature:	145°C, hold until all expected compounds have eluted.

7.2.6 Direct injection - Column 4

Carrier gas (He) flow rate:	4 mL/min
Column:	J&W DB-24, 70m x 0.53 mm
Initial temperature:	40°C, hold for 3 minutes
Temperature program:	8°C/min
Final temperature:	260°C, hold until all expected compounds have eluted.
Column Bake out (direct inj):	75 minutes
Injector temperature:	200-225°C
Transfer line temperature:	250-300°C

7.3 Initial calibration - the recommended MS operating conditions

Mass range:	35-260 amu	
Scan time:	0.6-2 sec/scan	
Source temperature:	According to manufacturer's specifications	
Ion trap only:	Axial modulation	4.0 volts
	Manifold set	220°C
	Emission current	30 amps

7.3.1 Each GC/MS system must be hardware-tuned to meet the criteria in Table 4 for a 5-50 ng injection or purging of 4-bromofluorobenzene (2 µL injection of the BFB standard). Analyses must not begin until these criteria are met.

7.3.2 Set up the purge-and-trap system as outlined in Method 5030 if purge-and-trap analysis is to be utilized. A set of at least five calibration standards containing the method analytes is needed. One calibration standard should contain each analyte at a concentration approaching but greater than the method detection limit (Table 1) for that compound; the other calibration standards should contain analytes at concentrations that define the range of the method. Calibration should be done using the sample introduction technique that will be used for samples. For Method 5030, the purging efficiency for 5 mL of water is greater than for 25 mL. Therefore, develop the standard curve with whichever volume of sample that will be analyzed.

7.3.2.1 To prepare a calibration standard for purge-and-trap or aqueous direct injection, add an appropriate volume of a secondary dilution standard solution to an aliquot of organic-free reagent water in a volumetric flask. Use a microsyringe and rapidly inject the alcoholic standard into the expanded area of the filled volumetric flask. Remove the needle as quickly as possible after injection. Mix by inverting the flask three times only. Discard the contents contained in the neck of the flask. Aqueous standards are not stable and should be prepared daily. Transfer 5.0 mL (or 25 mL if lower detection limits are required) of each standard to a gas tight syringe along with 10 µL of internal standard. Then transfer the contents to a purging device or syringe. Perform purge-and-trap or direct injection as outlined in Method 5030.

7.3.2.2 To prepare a calibration standard for direct injection analysis of oil, dilute standards in hexadecane.

7.3.3 Tabulate the area response of the characteristic ions (see Table 5) against concentration for each compound and each internal standard. Calculate response factors (RF) for each compound relative to one of the internal standards. The internal standard selected for the calculation of the RF for a compound should be the internal standard that has a retention time closest to the compound being measured (Section 7.6.2). The RF is calculated as follows:

$$RF = (A_x C_{is})/(A_{is} C_x)$$

where:

A_x = Area of the characteristic ion for the compound being measured.
A_{is} = Area of the characteristic ion for the specific internal standard.
C_{is} = Concentration of the specific internal standard.
C_x = Concentration of the compound being measured.

7.3.4 The average RRF must be calculated and recorded for each compound. A system performance check should be made before this calibration curve is used. Five compounds (the System Performance Check Compounds, or SPCCs) are checked for a minimum average relative response factor. These compounds are chloromethane; 1,1-dichloroethane; bromoform; 1,1,2,2-tetrachloroethane; and chlorobenzene. These compounds are used to check compound instability and to check for degradation caused by contaminated lines or active sites in the system. Examples of these occurrences are:

7.3.4.1 Chloromethane - This compound is the most likely compound to be lost if the purge flow is too fast.

7.3.4.2 Bromoform - This compound is one of the compounds most likely to be purged very poorly if the purge flow is too slow. Cold spots and/or active sites in the transfer lines may adversely affect response. Response of the quantitation ion (m/z 173) is directly affected by the tuning of BFB at ions m/z 174/176. Increasing the m/z 174/176 ratio relative to m/z 95 may improve bromoform response.

7.3.4.3 Tetrachloroethane and 1,1-dichloroethane - These compounds are degraded by contaminated transfer lines in purge-and-trap systems and/or active sites in trapping materials.

7.3.5 Using the RRFs from the initial calibration, calculate and record the percent relative standard deviation (%RSD) for all compounds. The percent RSD is calculated as follows:

$$\% \, RSD = \frac{SD}{\overline{RF}_x} \times 100\%$$

where:

RSD = Relative standard deviation.
RF_x = mean of 5 initial RRFs for a compound.
SD = standard deviation of average RRFs for a compound.

$$SD = \sqrt{\sum_{i=1}^{N} \frac{(x_i - \bar{x})^2}{N - 1}}$$

The percent relative standard deviation should be less than 15% for each compound. However, the %RSD for each individual Calibration Check Compound (CCC) must be less than 30%. The CCCs are:

1,1-Dichloroethene,
Chloroform,
1,2-Dichloropropane,
Toluene,
Ethylbenzene, and
Vinyl chloride.

7.3.5.1 If a %RSD greater than 30 percent is measured for any CCC, then corrective action to eliminate a system leak and/or column reactive sites is required before reattempting calibration.

7.3.6 Linearity - If the %RSD of any compound is 15% or less, then the relative response factor is assumed to be constant over the calibration range, and the average relative response factor may be used for quantitation.

7.3.6.1 If the %RSD of any compound is greater than 15%, construct calibration curves of area ratio (A/A_{is}) versus concentration using first or higher order regression fit of the five calibration points. The analyst should select the regression order which introduces the least calibration error into the quantitation. If the %RSD is <15%, use of calibration curves is a recommended alternative to average response factor calibration, and a useful diagnostic of standard preparation accuracy and absorption activity in the chromatographic system.

7.3.7 These curves are verified each shift by purging a performance standard. Recalibration is required only if calibration and on-going performance criteria cannot be met.

7.4 GC/MS calibration verification

7.4.1 Prior to the analysis of samples, inject or purge 5-50 ng of the 4-bromofluorobenzene standard following Method 5030. The resultant mass spectra for the BFB must meet all of the criteria given in Table 4 before sample analysis begins. These criteria must be demonstrated each 12-hour shift.

7.4.2 The initial calibration curve (Section 7.3) for each compound of interest must be checked and verified once every 12 hours during analysis with the introduction technique used for samples. This is accomplished by analyzing a calibration standard that is at a concentration near the midpoint concentration for the working range of the GC/MS by checking the SPCC and CCC.

7.4.3 System Performance Check Compounds (SPCCs) - A system performance check must be made each 12 hours. If the SPCC criteria are met, a comparison of relative response factors is made for all compounds. This is the same check that is applied during the initial calibration. If the minimum relative response factors are not met, the system must be evaluated, and corrective action must be taken before sample analysis begins. Some possible problems are standard mixture degradation, injection port inlet contamination, contamination at the front end of the analytical column, and active sites in the column or chromatographic system.

7.4.3.1 The minimum relative response factor for volatile SPCCs are as follows:

Chloromethane	0.1
1,1-Dichloroethane	0.1
Bromoform	0.25
Chlorobenzene	0.3
1,1,2,2-Tetrachloroethane	0.3

7.4.4 Calibration Check Compounds (CCCs) - After the system performance check is met, CCCs listed in Section 7.3.8 are used to check the validity of the initial calibration.

Calculate the percent drift using the following equation:

$$\% \text{ Drift} = (C_I - C_c)/C_I \times 100$$

where:

C_I = Calibration Check Compound standard concentration.
C_c = Measured concentration using selected quantitation method.

If the percent drift for each CCC is less than 20%, the initial calibration is assumed to be valid. If the criterion is not met (> 20% drift), for any one CCC, corrective action must be taken. Problems similar to those listed under SPCCs could affect this criterion. If no source of the problem can be determined after corrective action has been taken, a new five point calibration MUST be generated. This criterion MUST be met before quantitative sample analysis begins. If the CCCs are not required analytes by the permit, then all required analytes must meet the 20% drift criterion.

7.4.5 The internal standard responses and retention times in the check calibration standard must be evaluated immediately after or during data acquisition. If the retention time for any internal standard changes

by more than 30 seconds from the last check calibration (12 hours), the chromatographic system must be inspected for malfunctions and corrections must be made, as required. If the EICP area for any of the internal standards changes by a factor of two (-50% to +100%) from the last daily calibration standard check, the mass spectrometer must be inspected for malfunctions and corrections must be made, as appropriate. When corrections are made, reanalysis of samples analyzed while the system was malfunctioning are necessary.

7.4.6 For compounds which exhibit linearity of response, the RRF of the daily check standard may be used for quantitation, provided the criteria for SPCCs and CCCs are satisfied.

7.5 GC/MS analysis

7.5.1 It is highly recommended that the extract be screened on a headspace-GC/FID (Methods 3810/8015), headspace-GC/PID/ELCD (Methods 3810/8021), or waste dilution-GC/PID/ELCD (Methods 3585/8021) using the same type of capillary column. This will minimize contamination of the GC/MS system from unexpectedly high concentrations of organic compounds. Use of screening is particularly important when this method is used to achieve low detection levels.

7.5.2 All samples and standard solutions must be allowed to warm to ambient temperature before analysis. Set up the purge-and-trap system as outlined in Method 5030 if purge-and-trap introduction will be used.

7.5.3 BFB tuning criteria and GC/MS calibration verification criteria must be met before analyzing samples.

7.5.3.1 Remove the plunger from a 5 mL syringe and attach a closed syringe valve. If lower detection limits are required, use a 25 mL syringe. Open the sample or standard bottle, which has been allowed to come to ambient temperature, and carefully pour the sample into the syringe barrel to just short of overflowing. Replace the syringe plunger and compress the sample. Open the syringe valve and vent any residual air while adjusting the sample volume to 5.0 mL.

7.5.4 The process of taking an aliquot destroys the validity of aqueous and soil samples for future analysis; therefore, if there is only one VOA vial, the analyst should prepare a second aliquot for analysis at this time to protect against possible loss of sample integrity. This second sample is maintained only until such time when the analyst has determined that the first sample has been analyzed properly. For aqueous samples, filling one 20 mL syringe would require the use of only one syringe. If a second analysis is needed from a syringe, it must be analyzed within 24 hours. Care must be taken to prevent air from leaking into the syringe.

7.5.4.1 The following procedure is appropriate for diluting aqueous purgeable samples. All steps must be performed without delays until the diluted sample is in a gas-tight syringe.

7.5.4.1.1 Dilutions may be made in volumetric flasks (10 to 100 mL). Select the volumetric flask that will allow for the necessary dilution. Intermediate dilutions may be necessary for extremely large dilutions.

7.5.4.1.2 Calculate the approximate volume of organic-free reagent water to be added to the volumetric flask selected and add slightly less than this quantity of organic-free reagent water to the flask.

7.5.4.1.3 Inject the proper aliquot of sample from the syringe into the flask. Aliquots of less than 1 mL are not recommended. Dilute the sample to the mark with organic-free reagent water. Cap the flask, invert, and shake three times. Repeat above procedure for additional dilutions.

7.5.4.1.4 Fill a 5 mL syringe with the diluted sample.

7.5.4.2 Compositing aqueous samples prior to GC/MS analysis

7.5.4.2.1 Add 5 mL or equal larger amounts of each sample (up to 5 samples are allowed) to a 25 mL glass syringe. Special precautions must be made to maintain zero headspace in the syringe.

7.5.4.2.2 The samples must be cooled at 4°C during this step to minimize volatilization losses.

7.5.4.2.3 Mix well and draw out a 5 mL aliquot for analysis.

7.5.4.2.4 Follow sample introduction, purging, and desorption steps described in Method 5030.

7.5.4.2.5 If less than five samples are used for compositing, a proportionately smaller syringe may be used unless a 25 mL sample is to be purged.

7.5.5 Add 10.0 µL of surrogate spiking solution and 10 µL of internal standard spiking solution to each sample. The surrogate and internal standards may be mixed and added as a single spiking solution. The addition of 10 µL of the surrogate spiking solution to 5 mL of sample is equivalent to a concentration of 50 µg/L of each surrogate standard. The addition of 10 µL of the surrogate spiking solution to 5 g of sample is equivalent to a concentration of 50 µg/kg of each surrogate standard.

7.5.5.1 If a more sensitive mass spectrometer is employed to achieve lower detection levels, more dilute surrogate and internal standard solutions may be required.

7.5.6 Perform purge-and-trap or direct injection by Method 5030. If the initial analysis of sample or a dilution of the sample has a concentration of analytes that exceeds the initial calibration range, the

sample must be reanalyzed at a higher dilution. Secondary ion quantitation is allowed only when there are sample interferences with the primary ion. When a sample is analyzed that has saturated ions from a compound, this analysis must be followed by a blank organic-free reagent water analysis. If the blank analysis is not free of interferences, the system must be decontaminated. Sample analysis may not resume until the blank analysis is demonstrated to be free of interferences.

7.5.6.1. All dilutions should keep the response of the major constituents (previously saturated peaks) in the upper half of the linear range of the curve. Proceed to Sections 7.6.1 and 7.6.2 for qualitative and quantitative analysis.

7.5.7 For matrix spike analysis, add 10 µL of the matrix spike solution (Section 5.13) to the 5 mL of sample to be purged. Disregarding any dilutions, this is equivalent to a concentration of 50 µg/L of each matrix spike standard.

7.6 Data interpretation

7.6.1 Qualitative analysis

7.6.1.1 The qualitative identification of compounds determined by this method is based on retention time, and on comparison of the sample mass spectrum, after background correction, with characteristic ions in a reference mass spectrum. The reference mass spectrum must be generated by the laboratory using the conditions of this method. The characteristic ions from the reference mass spectrum are defined to be the three ions of greatest relative intensity, or any ions over 30% relative intensity if less than three such ions occur in the reference spectrum. Compounds should be identified as present when the criteria below are met.

7.6.1.1.1 The intensities of the characteristic ions of a compound maximize in the same scan or within one scan of each other. Selection of a peak by a data system target compound search routine where the search is based on the presence of a target chromatographic peak containing ions specific for the target compound at a compound-specific retention time will be accepted as meeting this criterion.

7.6.1.1.2 The RRT of the sample component is within ± 0.06 RRT units of the RRT of the standard component.

7.6.1.1.3 The relative intensities of the characteristic ions agree within 30% of the relative intensities of these ions in the reference spectrum. (Example: For an ion with an abundance of 50% in the reference spectrum, the corresponding abundance in a sample spectrum can range between 20% and 80%.)

7.6.1.1.4 Structural isomers that produce very similar mass spectra should be identified as individual isomers if they have sufficiently different GC retention times.

Sufficient GC resolution is achieved if the height of the valley between two isomer peaks is less than 25% of the sum of the two peak heights. Otherwise, structural isomers are identified as isomeric pairs.

7.6.1.1.5 Identification is hampered when sample components are not resolved chromatographically and produce mass spectra containing ions contributed by more than one analyte. When gas chromatographic peaks obviously represent more than one sample component (i.e., a broadened peak with shoulder(s) or a valley between two or more maxima), appropriate selection of analyte spectra and background spectra is important. Examination of extracted ion current profiles of appropriate ions can aid in the selection of spectra, and in qualitative identification of compounds. When analytes coelute (i.e., only one chromatographic peak is apparent), the identification criteria can be met, but each analyte spectrum will contain extraneous ions contributed by the coeluting compound.

7.6.1.2 For samples containing components not associated with the calibration standards, a library search may be made for the purpose of tentative identification. The necessity to perform this type of identification will be determined by the type of analyses being conducted. Guidelines for making tentative identification are:

(1) Relative intensities of major ions in the reference spectrum (ions > 10% of the most abundant ion) should be present in the sample spectrum.

(2) The relative intensities of the major ions should agree within ± 20%. (Example: For an ion with an abundance of 50% in the standard spectrum, the corresponding sample ion abundance must be between 30 and 70%).

(3) Molecular ions present in the reference spectrum should be present in the sample spectrum.

(4) Ions present in the sample spectrum but not in the reference spectrum should be reviewed for possible background contamination or presence of coeluting compounds.

(5) Ions present in the reference spectrum but not in the sample spectrum should be reviewed for possible subtraction from the sample spectrum because of background contamination or coeluting peaks. Data system library reduction programs can sometimes create these discrepancies.

Computer generated library search routines should not use normalization routines that would misrepresent the library or unknown spectra when compared to each other. Only after visual comparison

of sample with the nearest library searches will the mass spectral interpretation specialist assign a tentative identification.

7.6.2 Quantitative analysis

7.6.2.1 When a compound has been identified, the quantitation of that compound will be based on the integrated abundance from the EICP of the primary characteristic ion. Quantitation will take place using the internal standard technique. The internal standard used shall be the one nearest the retention time of that of a given analyte.

7.6.2.2 When MS response is linear and passes through the origin, calculate the concentration of each identified analyte in the sample as follows:

Water

$$\text{concentration } (\mu g/L) = \frac{(A_x)(I_s)}{(A_{is})(\overline{RRF})(V_o)}$$

where:

A_x = Area of characteristic ion for compound being measured.
I_s = Amount of internal standard injected (ng).
A_{is} = Area of characteristic ion for the internal standard.
$\overline{RRF}$ = Relative Response factor for compound being measured.
V_o = Volume of water purged (mL), taking into consideration any dilutions made.

Sediment/Soil Sludge (on a dry-weight basis) and Waste (normally on a wet-weight basis)

$$\text{concentration } (\mu g/kg) = \frac{(A_x)(I_s)(V_t)}{(A_{is})(\overline{RRF})(V_i)(W_s)(D)}$$

where:

A_x, I_s, A_{is}, $\overline{RRF}$, = Same as for water.
V_t = Volume of total extract (μL) (use 10,000 μL or a factor of this when dilutions are made).
V_i = Volume of extract added (μL) for purging.
W_s = Weight of sample extracted or purged (g).
D = % dry weight of sample/100, or 1 for a wet-weight basis.

7.6.2.3 Where applicable, an estimate of concentration for noncalibrated components in the sample should be made. The formulae given above should be used with the following modifications: The

areas A_x and A_{is} should be from the total ion chromatograms, and the RRF for the compound should be assumed to be 1. The concentration obtained should be reported indicating (1) that the value is an estimate and (2) which internal standard was used to determine concentration. Use the nearest internal standard free of interferences.

8.0 QUALITY CONTROL

8.1 Refer to Chapter One and Method 8000 for general quality control procedures.

8.2 Additional required instrument QC is found in the Sections 7.3 and 7.4:

8.2.1 The GC/MS system must be tuned to meet the BFB specifications.

8.2.2 There must be an initial calibration of the GC/MS system

8.2.3 The GC/MS system must meet the SPCC criteria and the CCC criteria, each 12 hours.

8.3 To establish the ability to generate acceptable accuracy and precision, the analyst must perform the following operations.

8.3.1 A quality control (QC) reference sample concentrate is required containing each analyte at a concentration of 10 mg/L or less in methanol. The QC reference sample concentrate may be prepared from pure standard materials or purchased as certified solutions. If prepared by the laboratory, the QC reference sample concentrate must be made using stock standards prepared independently from those used for calibration.

8.3.2 Prepare a QC reference sample to contain 20 µg/L or less of each analyte by adding 200 µL of QC reference sample concentrate to 100 mL of organic-free reagent water.

8.3.3 Four 5 mL aliquots of the well mixed QC reference sample are analyzed according to the method beginning in Section 7.5.1.

8.3.4 Calculate the average recovery ($\bar{x}$) in µg/L, and the standard deviation of the recovery (s) in µg/L, for each analyte using the four results.

8.3.5 Tables 7 and 8 provide single laboratory recovery and precision data obtained for the method analytes from water. Similar results from dosed water should be expected by any experienced laboratory. Compare s and $\bar{x}$ (Section 8.3.4) for each analyte to the single laboratory recovery and precision data. Results are comparable if the calculated standard deviation of the recovery does not exceed 2.6 times the single laboratory RSD or 20%, whichever is greater, and the mean recovery lies within the interval $\bar{x} \pm 3S$ or $\bar{x} \pm 30\%$, whichever is greater.

NOTE: The large number of analytes in Tables 7 and 8 present a substantial probability that one or more will fail at least one of the acceptance criteria when all analytes of a given method are determined.

8.3.6 When one or more of the analytes tested are not comparable to the data in Table 6 or 7, the analyst must proceed according to Section 8.3.6.1 or 8.3.6.2.

8.3.6.1 Locate and correct the source of the problem and repeat the test for all analytes beginning with Section 8.3.2.

8.3.6.2 Beginning with Section 8.3.2, repeat the test only for those analytes that are not comparable. Repeated failure, however, will confirm a general problem with the measurement system. If this occurs, locate and correct the source of the problem and repeat the test for all compounds of interest beginning with Section 8.3.2.

8.4 For aqueous and soil matrices, laboratory established surrogate control limits should be compared with the control limits listed in Table 8.

8.4.1 If recovery is not within limits, the following procedures are required.

8.4.1.1 Check to be sure that there are no errors in the calculations, surrogate solutions or internal standards. If errors are found, recalculate the data accordingly.

8.4.1.2 Check instrument performance. If an instrument performance problem is identified, correct the problem and re-analyze the extract.

8.4.1.3 If no problem is found, re-extract and re-analyze the sample.

8.4.1.4 If, upon re-analysis, the recovery is again not within limits, flag the data as "estimated concentration".

8.4.2 At a minimum, each laboratory should update surrogate recovery limits on a matrix-by-matrix basis, annually.

9.0 METHOD PERFORMANCE

9.1 The method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the value is above zero. The MDL actually achieved in a given analysis will vary depending on instrument sensitivity and matrix effects.

9.2 This method has been tested in a single laboratory using spiked water. Using a wide-bore capillary column, water was spiked at concentrations between 0.5 and 10 µg/L. Single laboratory accuracy and precision data are

presented for the method analytes in Table 6. Calculated MDLs are presented in Table 1.

9.3 The method was tested using water spiked at 0.1 to 0.5 µg/L and analyzed on a cryofocussed narrow-bore column. The accuracy and precision data for these compounds are presented in Table 7. MDL values were also calculated from these data and are presented in Table 2.

9.4 Direct injection has been used for the analysis of waste motor oil samples using a wide-bore column. The accuracy and precision data for these compounds are presented in Table 10.

10.0 REFERENCES

1. Methods for the Determination of Organic Compounds in Finished Drinking Water and Raw Source Water Method 524.2; U.S. Environmental Protection Agency. Office of Research Development. Environmental Monitoring and Support Laboratory: Cincinnati, OH 1986.

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TABLE 1.
CHROMATOGRAPHIC RETENTION TIMES AND METHOD DETECTION LIMITS (MDL)
FOR VOLATILE ORGANIC COMPOUNDS ON WIDE BORE CAPILLARY COLUMNS

ANALYTE	RETENTION TIME (minutes)			MDL[d] (µg/L)
	Column 1[a]	Column 2[b]	Column 2'[c]	
Chloromethane	1.49	0.73	3.40	0.13
Vinyl Chloride	1.56	0.79	3.93	0.17
Bromomethane	2.19	0.96	4.80	0.11
Chloroethane	2.21	1.02	--	0.10
Trichlorofluoromethane	2.42	1.19	6.20	0.08
	3.19			
Carbon disulfide	4.11			
Methylene chloride	4.40	2.06	9.27	0.03
1,1-Dichloroethene	4.57	1.57	7.83	0.12
Acetone	4.57			
trans-1,2-Dichloroethene	4.57	2.36	9.90	0.06
1,1-Dichloroethane	6.14	2.93	10.80	0.04
Vinyl acetate	6.43			
2-Butanone	--			
cis-1,2-Dichloroethene	8.25	3.90	11.93	0.12
Chloroform	9.01	4.80	12.60	0.03
Bromochloromethane	--	4.38	12.37	0.04
1,1,1-Trichloroethane	10.18	4.84	12.83	0.08
Carbon tetrachloride	11.02	5.26	13.17	0.21
Benzene	11.50	5.67	13.50	0.04
1,2-Dichloroethane	12.09	5.83	13.63	0.06
Trichloroethene	14.03	7.27	14.80	0.19
1,2-Dichloropropane	14.51	7.66	15.20	0.04
Bromodichloromethane	15.39	8.49	15.80	0.08
2-Chloroethyl vinyl ether	--			
4-Methyl-2-pentanone	17.32			
trans-1,3-Dichloropropene	17.47	--	16.70	--
Toluene	18.29	10.00	17.40	0.11
cis-1,3-Dichloropropene	19.38	--	17.90	--
1,1,2-Trichloroethane	19.59	11.05	18.30	0.10

TABLE 1.
(Continued)

ANALYTE	RETENTION TIME (minutes) Column 1[a]	Column 2[b]	Column 2'[c]	MDL[d] (µg/L)
2-Hexanone	20.30			
Tetrachloroethene	20.26	11.15	18.60	0.14
Dibromochloromethane	21.19	11.85	19.20	0.05
Chlorobenzene	23.17	13.01	20.67	0.04
Ethylbenzene	23.38	13.39	21.00	0.06
p-Xylene	23.54	13.69	21.30	0.13
m-Xylene	23.54	13.68	21.37	0.05
o-Xylene	25.16	14.52	22.27	0.11
Styrene	25.30	14.60	22.40	0.04
Bromoform	26.23	14.88	22.77	0.12
1,1,2,2-Tetrachloroethane	27.29	16.35	24.07	0.04

TABLE 1.
(Continued)

ANALYTE	RETENTION TIME (minutes)			MDL[d] (µg/L)
	Column 1[a]	Column 2[b]	Column 2'[c]	
INTERNAL STANDARDS/SURROGATES				
1,4-Difluorobenzene	13.26			
Chlorobenzene-d_5	23.10			
1,4-Dichlorobenzene-d_4	31.16			
4-Bromofluorobenzene	27.83	15.71	23.63	
1,2-Dichlorobenzene-d_4	32.30	19.08	27.25	
Dichloroethane-d_4	12.08			
Dibromofluoromethane	--			
Toluene-d_8	18.27			
Pentafluorobenzene	--			
Fluorobenzene	13.00	6.27	14.06	

[a] Column 1 - 60 meter x 0.75 mm ID VOCOL capillary. Hold at 10°C for 8 minutes, then program to 180°C at 4°/min.

[b] Column 2 - 30 meter x 0.53 mm ID DB-624 wide-bore capillary using cryogenic oven. Hold at 10°C for 5 minutes, then program to 160°C at 6°/min.

[c] Column 2' - 30 meter x 0.53 mm ID DB-624 wide-bore capillary, cooling GC oven to ambient temperatures. Hold at 10°C for 6 minutes, program to 70°C at 10°/min, program to 120°C at 5°/min, then program to 180°C at 8°/min.

[d] MDL based on a 25 mL sample volume.

TABLE 2.
CHROMATOGRAPHIC RETENTION TIMES AND METHOD DETECTION LIMITS (MDL)
FOR VOLATILE ORGANIC COMPOUNDS ON NARROW BORE CAPILLARY COLUMNS

ANALYTE	RETENTION TIME (minutes) Column 3[a]	MDL[b] (µg/L)
Chloromethane	0.97	0.05
Vinyl chloride	1.04	0.04
Bromomethane	1.29	0.06
Chloroethane	1.45	0.02
Trichlorofluoromethane	1.77	0.07
1,1-Dichloroethene	2.33	0.05
Methylene chloride	2.66	0.09
trans-1,2-Dichloroethene	3.54	0.03
1,1-Dichloroethane	4.03	0.03
cis-1,2-Dichloroethene	5.07	0.06
Chloroform	5.55	0.04
Bromochloromethane	5.63	0.09
1,1,1-Trichloroethane	6.76	0.04
1,2-Dichloroethane	7.00	0.02
Carbon tetrachloride	7.41	0.02
Benzene	7.41	0.03
1,2-Dichloropropane	8.94	0.02
Trichloroethene	9.02	0.02
Bromodichloromethane	9.34	0.03
Toluene	11.51	0.08
1,1,2-Trichloroethane	11.99	0.08
Tetrachloroethene	13.20	0.05
Chlorobenzene	14.33	0.03
Ethylbenzene	14.73	0.03
p-Xylene	15.30	0.06
m-Xylene	15.30	0.03
Bromoform	15.70	0.20
o-Xylene	15.78	0.06
Styrene	15.78	0.27
1,1,2,2-Tetrachloroethane	15.78	0.20

TABLE 2.
(Continued)

ANALYTE	RETENTION TIME (minutes) Column 3[a]	MDL[b] (µg/L)

[a] Column 3 - 30 meter x 0.32 mm ID DB-5 capillary with 1 µm film thickness.

[b] MDL based on a 25 mL sample volume.

TABLE 3.
ESTIMATED QUANTITATION LIMITS FOR VOLATILE ANALYTES[a]

	Estimated Quantitation Limits		
	Ground water µg/L		Low Soil/Sediment[b] µg/kg
Volume of water purged	5 mL	25 mL	
All analytes in Table 1	5	1	5

[a] Estimated Quantitation Limit (EQL) - The lowest concentration that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions. The EQL is generally 5 to 10 times the MDL. However, it may be nominally chosen within these guidelines to simplify data reporting. For many analytes the EQL analyte concentration is selected for the lowest non-zero standard in the calibration curve. Sample EQLs are highly matrix-dependent. The EQLs listed herein are provided for guidance and may not always be achievable. See the following information for further guidance on matrix-dependent EQLs.

[b] EQLs listed for soil/sediment are based on wet weight. Normally data is reported on a dry weight basis; therefore, EQLs will be higher, based on the percent dry weight in each sample.

Other Matrices	Factor[c]
Water miscible liquid waste	50
High-concentration soil and sludge	125
Non-water miscible waste	500

[c]EQL = [EQL for low soil sediment (Table 3)] X [Factor]. For non-aqueous samples, the factor is on a wet-weight basis.

TABLE 4.
BFB MASS - INTENSITY SPECIFICATIONS (4-BROMOFLUOROBENZENE)

Mass	Intensity Required (relative abundance)
50	15 to 40% of mass 95
75	30 to 60% of mass 95
95	base peak, 100% relative abundance
96	5 to 9% of mass 95
173	less than 2% of mass 174
174	greater than 50% of mass 95
175	5 to 9% of mass 174
176	greater than 95% but less than 101% of mass 174
177	5 to 9% of mass 176

TABLE 5.
CHARACTERISTIC MASSES (M/Z) FOR PURGEABLE ORGANIC COMPOUNDS

Analyte	Primary Characteristic Ion	Secondary Characteristic Ion(s)
Acetone	58	43
Benzene	78	-
Bromodichloromethane	83	85, 127
Bromoform	173	175, 254
Bromomethane	94	96
2-Butanone	72	43, 72
Carbon disulfide	76	78
Carbon tetrachloride	117	119
Chlorobenzene	112	77, 114
Chloroethane	64	66
Chloroform	83	85
Chloromethane	50	52
Dibromochloromethane	129	127

TABLE 5.
(continued)

Analyte	Primary Characteristic Ion	Secondary Characteristic Ion(s)
1,1-Dichloroethane	63	65, 83
1,2-Dichloroethane	62	98
1,1-Dichloroethene	96	61, 63
cis-1,2-Dichloroethene	96	61, 98
trans-1,2-Dichloroethene	96	61, 98
1,2-Dichloropropane	63	112
cis-1,3-Dichloropropene	75	77, 39
trans-1,3-Dichloropropene	75	77, 39
Ethylbenzene	91	106
2-Hexanone	43	58, 57, 100
Methylene chloride	84	86, 49
4-Methyl-2-pentanone	100	43, 58, 85

TABLE 5.
(continued)

Analyte	Primary Characteristic Ion	Secondary Characteristic Ion(s)
Styrene	104	78
1,1,2,2-Tetrachloroethane	83	131, 85
Tetrachloroethene	164	129, 131, 166
Toluene	92	91
1,1,1-Trichloroethane	97	99, 61
1,1,2-Trichloroethane	83	97, 85
Trichloroethene	95	97, 130, 132
Vinyl chloride	62	64
o-Xylene	106	91
m-Xylene	106	91
p-Xylene	106	91
INTERNAL STANDARDS/SURROGATES		
1,4-Difluorobenzene	114	
Chlorobenzene-d_5	117	
1,4-Dichlorobenzene-d_4	152	115, 150
4-Bromofluorobenzene	95	174, 176
Dibromofluoromethane	113	
Dichloroethane-d_4	102	
Toluene-d_8	98	
Pentafluorobenzene	168	
Fluorobenzene	96	77

TABLE 6.
SINGLE LABORATORY ACCURACY AND PRECISION DATA FOR VOLATILE ORGANIC COMPOUNDS IN WATER DETERMINED WITH A WIDE BORE CAPILLARY COLUMN

Analyte	Conc. Range, µg/L	Number of Samples	Recovery[a] %	Standard Deviation of Recovery[b]	Percent Rel Std Dev.
Benzene	0.1 - 10	31	97	6.5	5.7
Bromodichloromethane	0.1 - 10	30	95	5.7	6.1
Bromoform	0.5 - 10	18	101	6.4	6.3
Bromomethane	0.5 - 10	18	95	7.8	8.2
Carbon tetrachloride	0.5 - 10	24	84	7.4	8.8
Chlorobenzene	0.1 - 10	31	98	5.8	5.9
Chloroethane	0.5 - 10	24	89	8.0	9.0
Chloroform	0.5 - 10	24	90	5.5	6.1
Chloromethane	0.5 - 10	23	93	8.3	8.9
Dibromochloromethane	0.1 - 10	31	92	6.5	7.0
1,1-Dichloroethene	0.1 - 10	34	94	6.3	6.7
cis-1,2-Dichloroethene	0.5 - 10	18	101	6.7	6.7
trans-1,2-Dichloroethene	0.1 - 10	30	93	5.2	5.6
1,2-Dichloropropane	0.1 - 10	30	97	5.9	6.1
Ethylbenzene	0.1 - 10	31	99	8.4	8.6
Methylene chloride	0.1 - 10	30	95	5.0	5.3
Styrene	0.1 -100	39	102	7.3	7.2

TABLE 6.
(Continued)

Analyte	Conc. Range, µg/L	Number of Samples	Recovery[a] %	Standard Deviation of Recovery[b]	Percent Rel Std Dev.
1,1,2,2-Tetrachloroethane	0.1 - 10	30	91	5.7	6.3
Tetrachloroethene	0.5 - 10	24	89	6.0	6.8
Toluene	0.5 - 10	18	102	8.1	8.0
1,1,1-Trichloroethane	0.5 - 10	18	98	7.9	8.1
1,1,2-Trichloroethane	0.5 - 10	18	104	7.6	7.3
Trichloroethene	0.5 - 10	24	90	6.5	7.3
Vinyl chloride	0.5 - 10	18	98	6.5	6.7
o-Xylene	0.1 - 31	18	103	7.4	7.2
m-Xylene	0.1 - 10	31	97	6.3	6.5
p-Xylene	0.5 - 10	18	104	8.0	7.7

[a] Recoveries were calculated using internal standard method. Internal standard was fluorobenzene.

[b] Standard deviation was calculated by pooling data form three concentrations.

TABLE 7.
SINGLE LABORATORY ACCURACY AND PRECISION DATA FOR
VOLATILE ORGANIC COMPOUNDS IN WATER DETERMINED
WITH A NARROW BORE CAPILLARY COLUMN

Analyte	Conc. µg/L	Number of Samples	Recovery[a] %	Standard Deviation of Recovery	Percent Rel Std Dev.
Benzene	0.1	7	99	6.2	6.3
Bromodichloromethane	0.1	7	100	4.6	4.6
Bromoform	0.5	7	101	5.4	5.3
Bromomethane	0.5	7	99	7.1	7.2
Carbon tetrachloride	0.1	7	108	6.8	6.3
Chlorobenzene	0.1	7	91	5.8	6.4
Chloroethane	0.1	7	100	5.8	5.8
Chloroform	0.1	7	105	3.2	3.0
Chloromethane	0.5	7	101	4.7	4.7
Dibromochloromethane	0.1	7	99	5.6	5.7
1,1-Dichloroethane	0.5	7	98	6.2	6.3
1,2-Dichloroethane	0.1	7	100	6.3	6.3
1,1-Dichloroethene	0.1	7	95	9.0	9.5
cis-1,2-Dichloroethene	0.1	7	100	3.7	3.7
trans-1,2-Dichloroethene	0.1	7	98	7.2	7.3
1,2-Dichloropropane	0.5	7	96	6.0	6.3
Ethylbenzene	0.5	7	99	5.2	5.3
Methylene chloride	0.5	7	97	13.0	13.4

TABLE 7.
(Continued)

Analyte	Conc. µg/L	Number of Samples	Recovery[a] %	Standard Deviation of Recovery	Percent Rel Std Dev
Styrene	0.5	7	96	19.0	19.8
1,1,2,2-Tetrachloroethane	0.5	7	100	12.0	12.0
Tetrachloroethene	0.1	7	96	5.0	5.2
Toluene	0.5	7	100	5.9	5.9
1,1,1-Trichloroethane	0.5	7	100	4.0	4.0
1,1,2-Trichloroethane	0.5	7	102	4.9	4.8
Trichloroethene	0.1	7	104	2.0	1.9
Vinyl chloride	0.1	7	104	0.2	0.2
o-Xylene	0.5	7	106	7.5	7.1
m-Xylene	0.5	7	106	4.6	4.3
p-Xylene	0.5	7	97	6.1	6.3

[a] Recoveries were calculated using internal standard method. Internal standard was fluorobenzene.

TABLE 8.
SURROGATE SPIKE RECOVERY LIMITS FOR WATER AND SOIL/SEDIMENT SAMPLES

Surrogate Compound	Low/High Water	Low/High Soil/Sediment
4-Bromofluorobenzene[a]	86-115	74-121
Dibromofluoromethane[a]	86-118	80-120
Toluene-d_8[a]	88-110	81-117
Dichloroethane-d_4[a]	80-120	80-120

[a] Single laboratory data for guidance only.

TABLE 9.
QUANTITY OF EXTRACT REQUIRED FOR ANALYSIS OF HIGH-CONCENTRATION SAMPLES

Approximate Concentration Range	Volume of Extract[a]
500 - 10,000 µg/kg	100 µL
1,000 - 20,000 µg/kg	50 µL
5,000 - 100,000 µg/kg	10 µL
25,000 - 500,000 µg/kg	100 µL of 1/50 dilution[b]

Calculate appropriate dilution factor for concentrations exceeding this table.

[a] The volume of solvent added to 5 mL of water being purged should be kept constant. Therefore, add to the 5 mL syringe whatever volume of solvent is necessary to maintain a volume of 100 µL added to the syringe.

[b] Dilute an aliquot of the solvent extract and then take 100 µL for analysis.

TABLE 10
DIRECT INJECTION ANALYSIS OF NEW OIL AT 5 PPM

Compound	Recovery (%)	%RSD	Blank (ppm)	Spike (ppm)
Acetone	91	14.8	1.9	5.0
Benzene	86	21.3	0.1	0.5
Carbon tetrachloride	86	44.7	0.0	0.5
Carbon disulfide**	53	22.3	0.0	5.0
Chlorobenzene	81	29.3	0.0	5.0
Chloroform	84	29.3	0.0	6.0
1,2-Dichloroethane	101	23.1	0.0	0.5
1,1-Dichloroethene	97	45.3	0.0	0.7
Ethylbenzene	83	30.1	0.2	5.0
Methylene chloride	98	45.3	0.0	5.0
Methyl ethyl ketone	79	24.6	0.4	5.0
MIBK	93	31.4	0.0	5.0
Tetrachloroethene	82	27.1	0.0	0.7
Toluene	73	21.9	0.6	5.0
Trichloroethene	66	28.0	0.0	0.5
Vinyl chloride	63	35.2	0.0	0.2
o-Xylene	83	29.5	0.4	5.0
m/p-Xylene	84	29.5	0.6	10.0

* Alternate mass employed
** IS quantitation
Data is taken from Reference 9.

FIGURE 1.
PURGING DEVICE

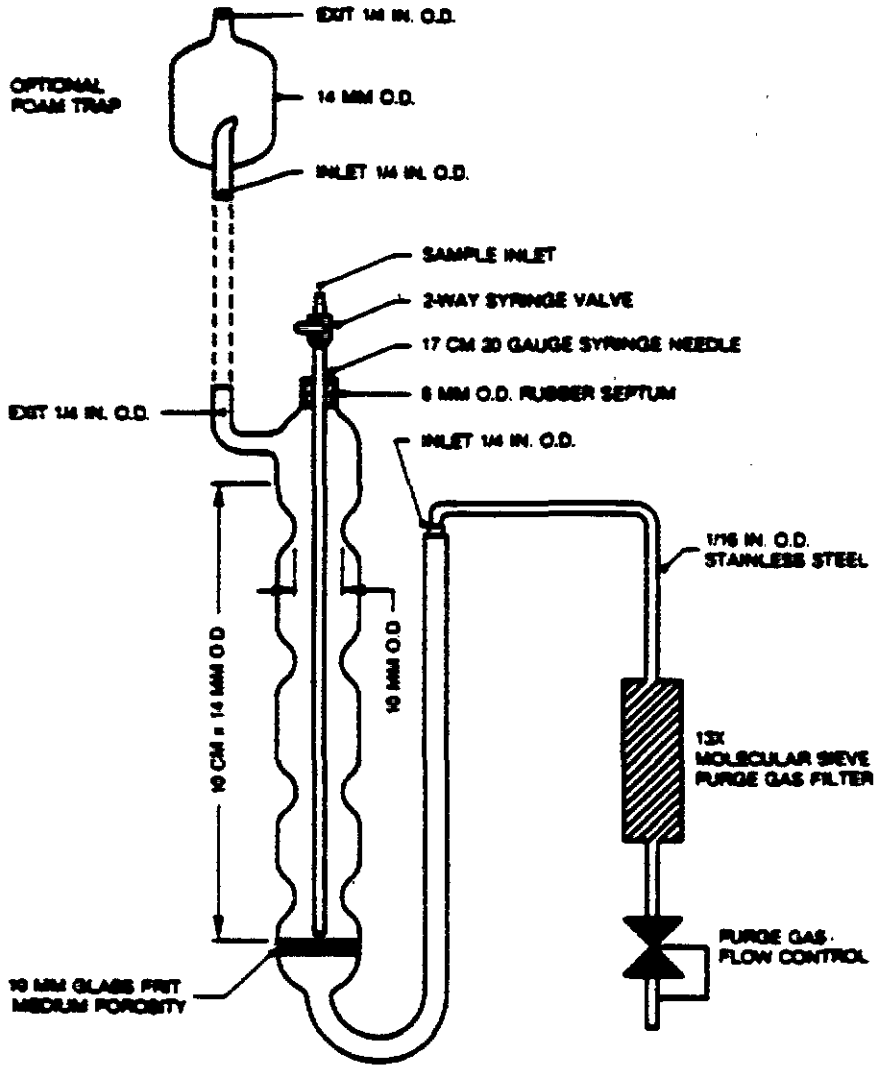


FIGURE 2.
TRAP PACKING AND CONSTRUCTION TO INCLUDE DESORB CAPABILITY

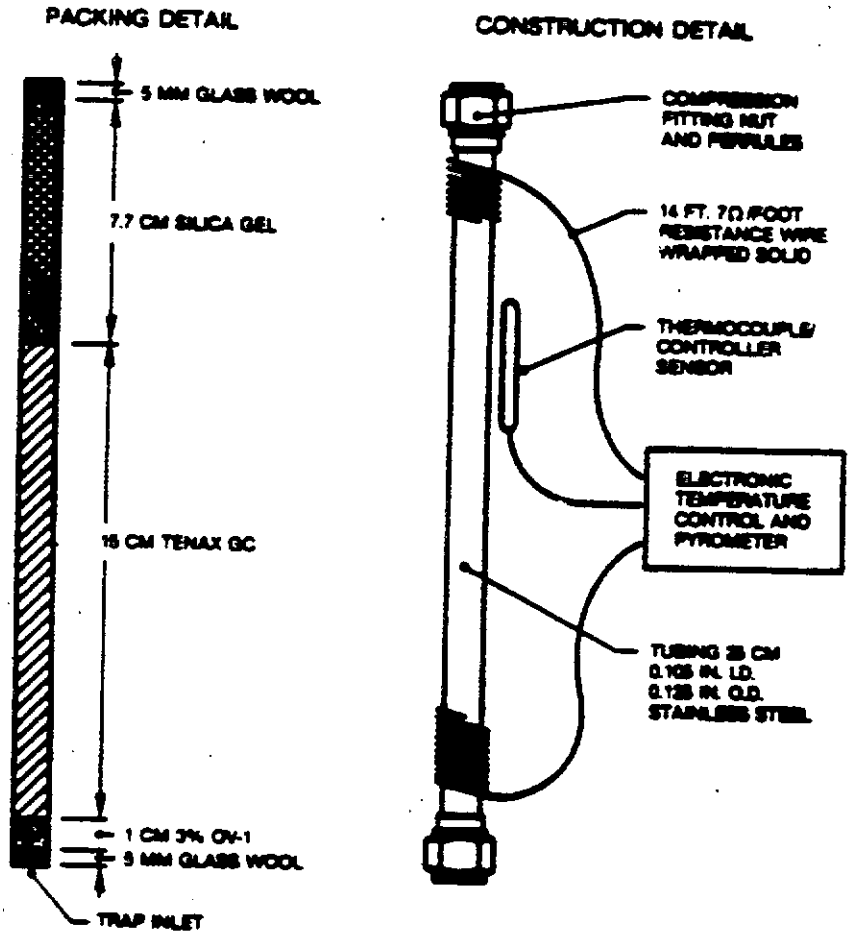


FIGURE 3.
SCHEMATIC OF PURGE-AND-TRAP DEVICE - PURGE MODE

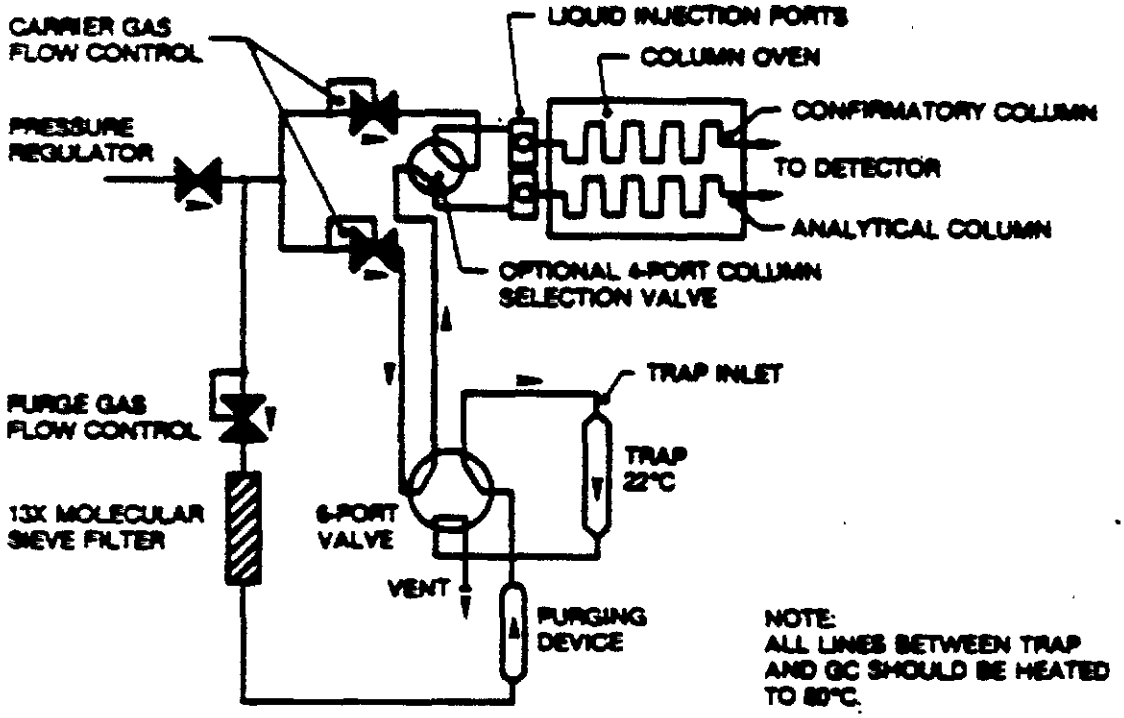


FIGURE 4.
SCHEMATIC OF PURGE-AND-TRAP DEVICE - DESORB MODE

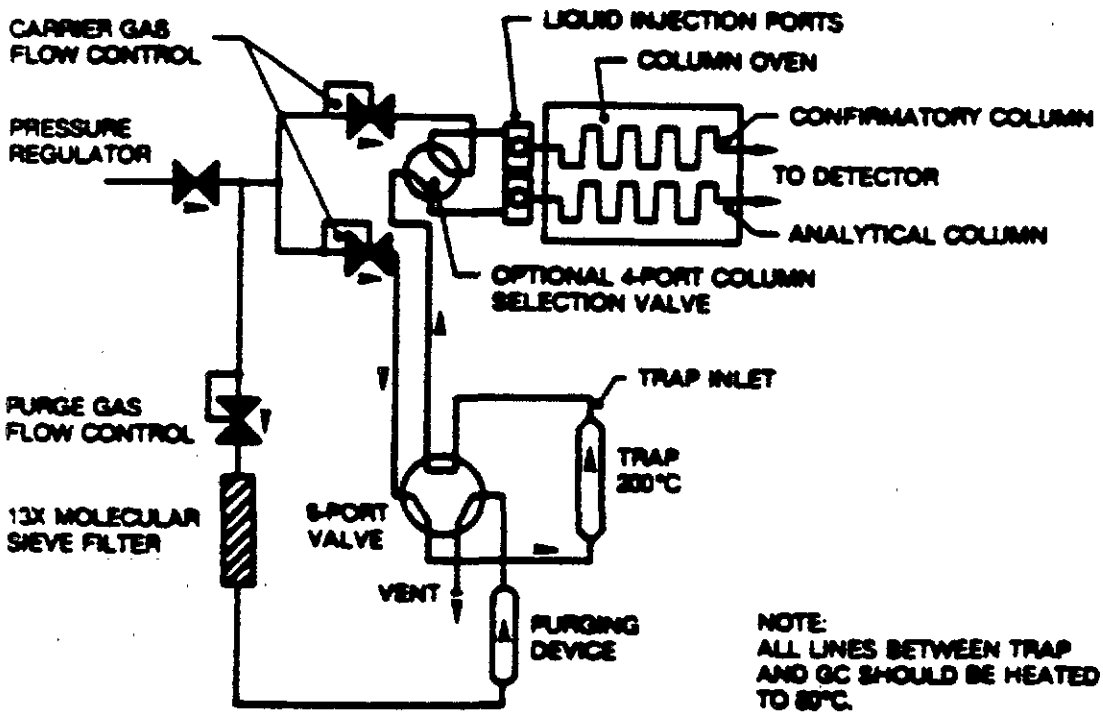


FIGURE 5.
GAS CHROMATOGRAM OF VOLATILE ORGANICS

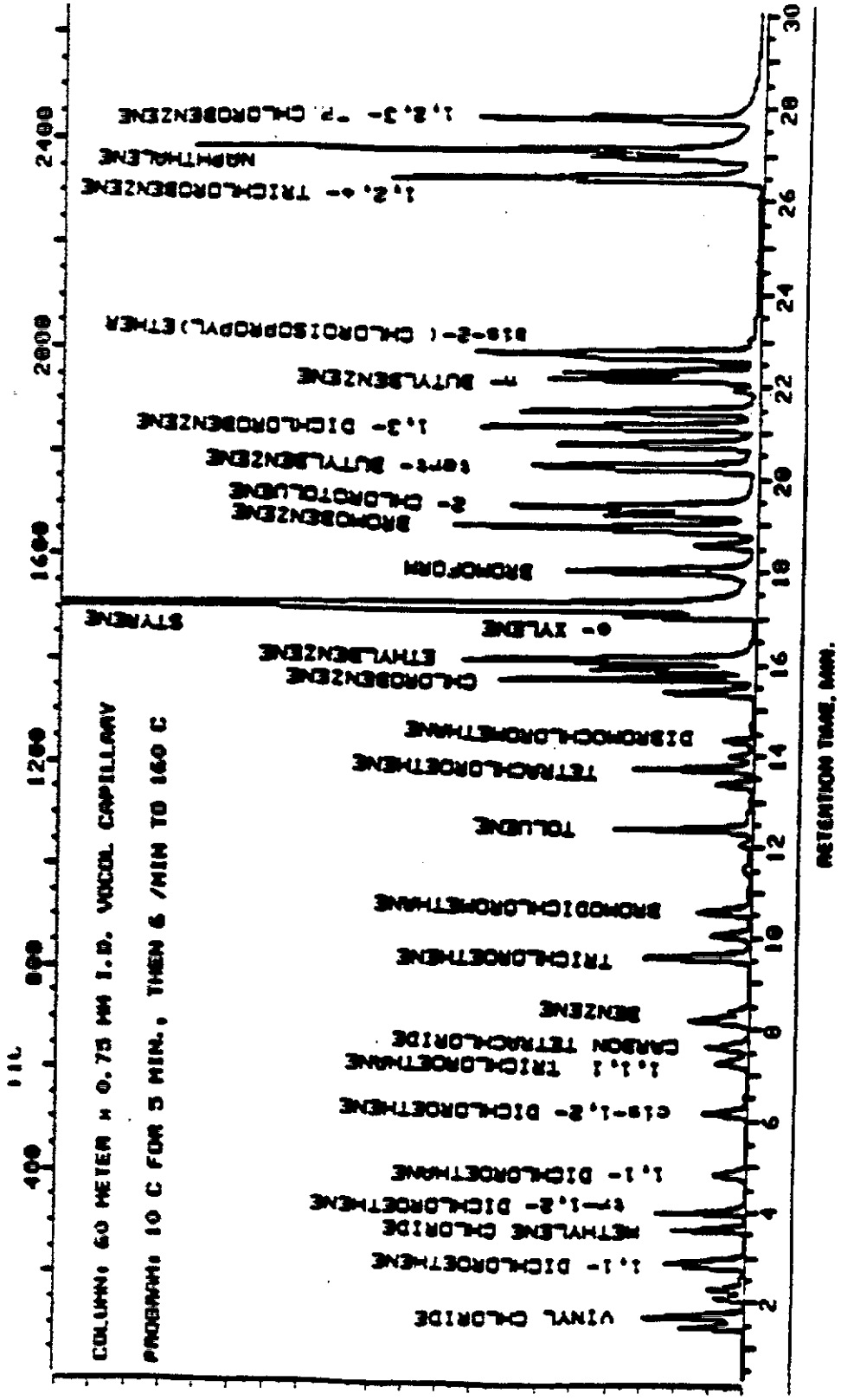


FIGURE 6.
GAS CHROMATOGRAM OF VOLATILE ORGANICS

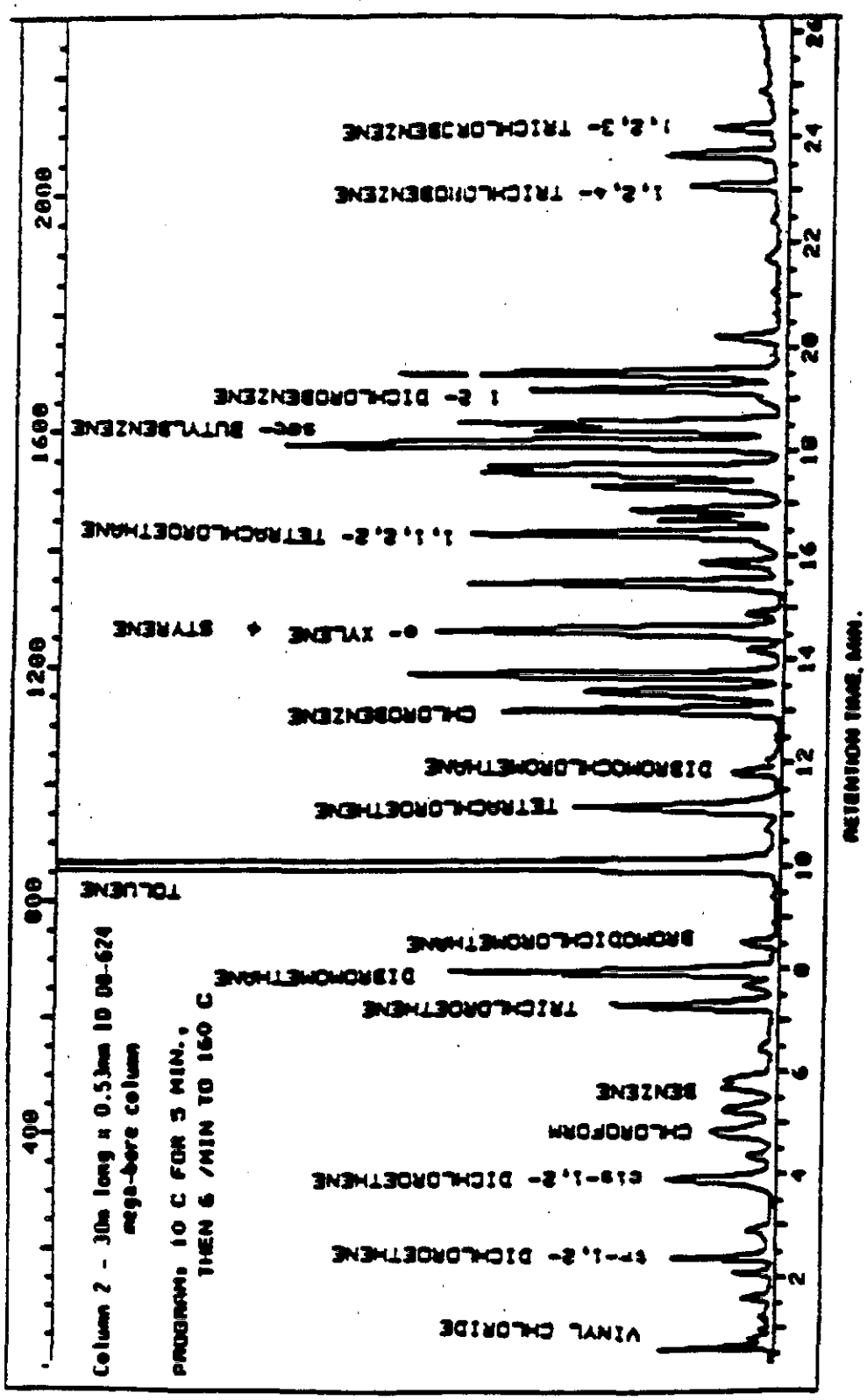
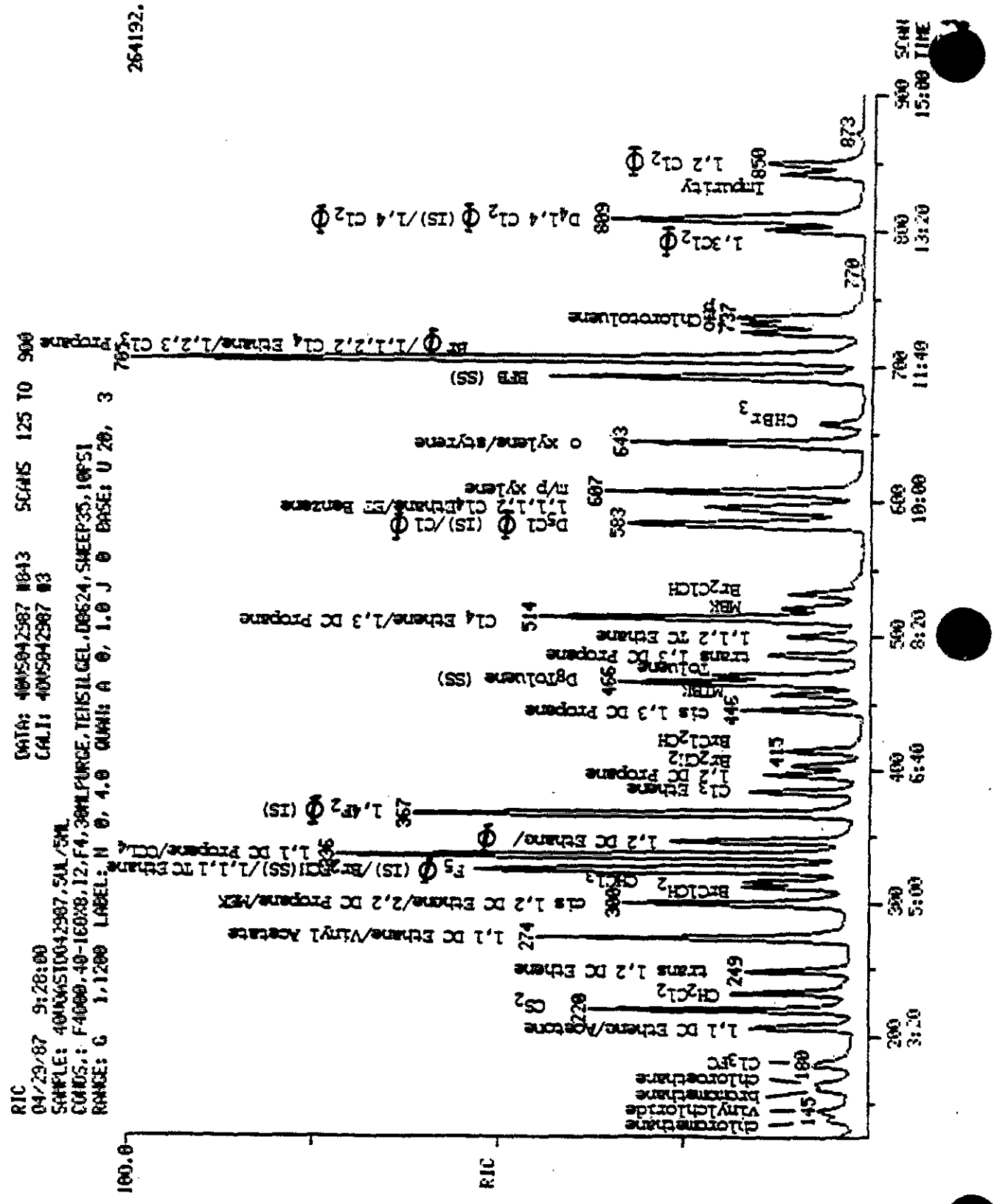


FIGURE 7.
GAS CHROMATOGRAM OF VOLATILE ORGANICS



AR303375

FIGURE 8.
GAS CHROMATOGRAM OF TEST MIXTURE

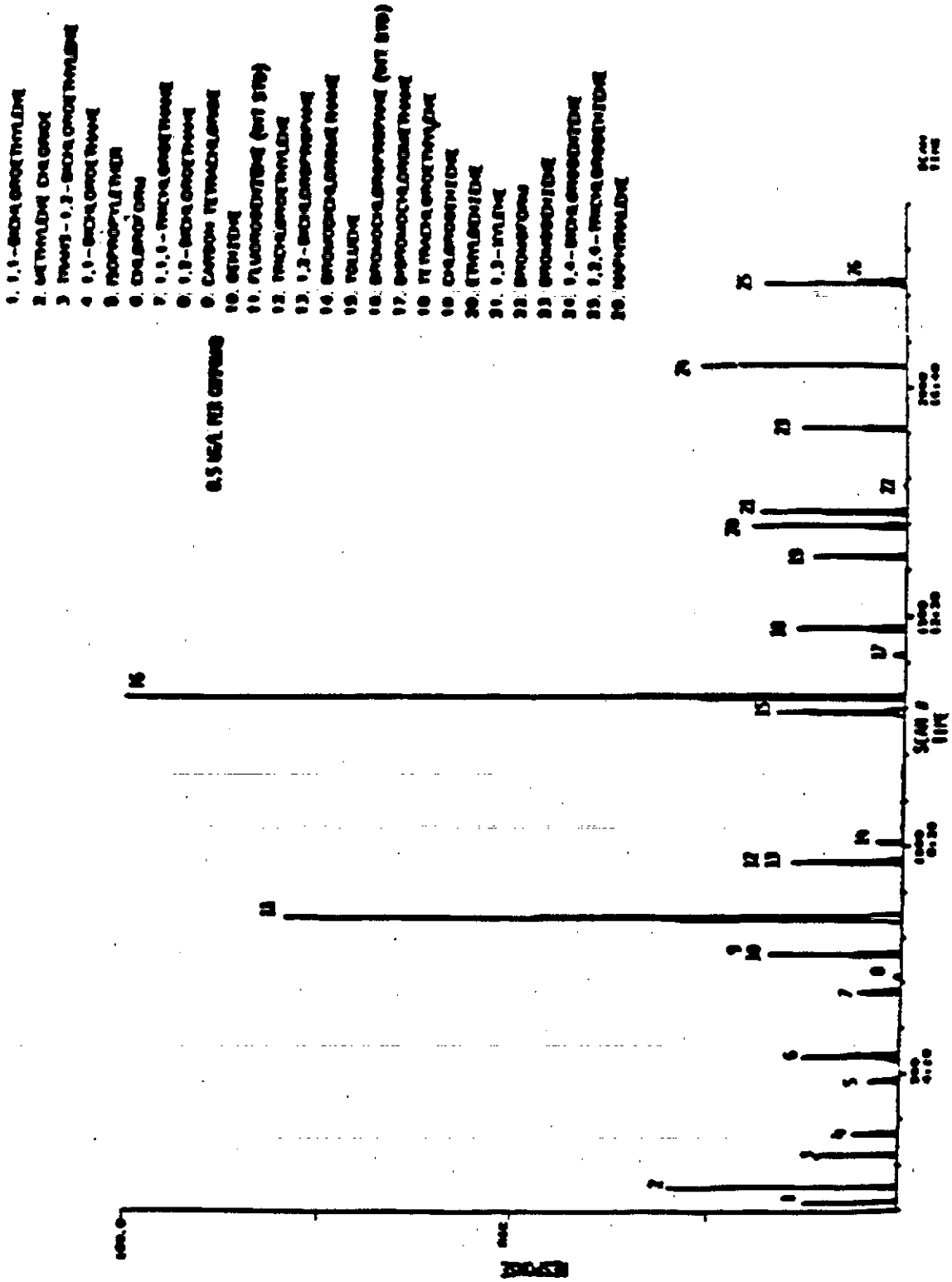
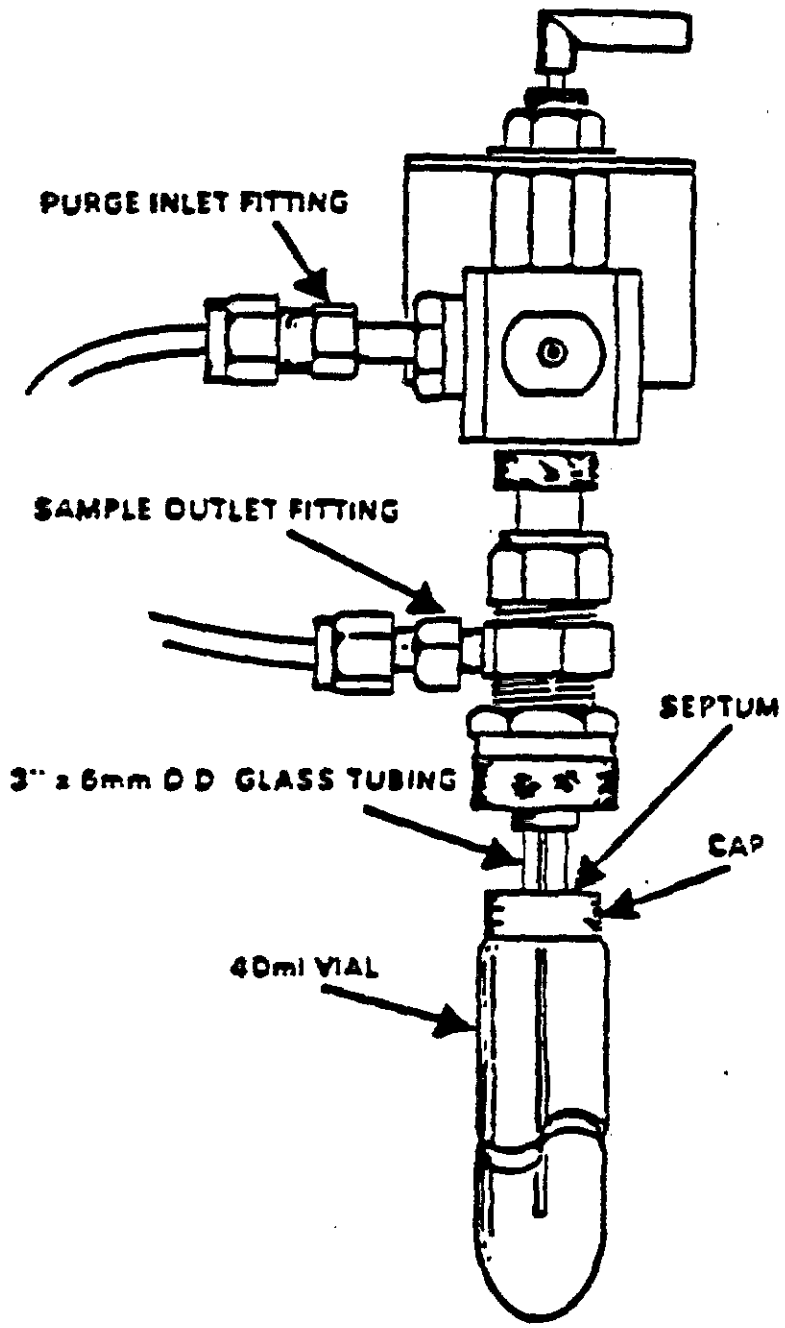
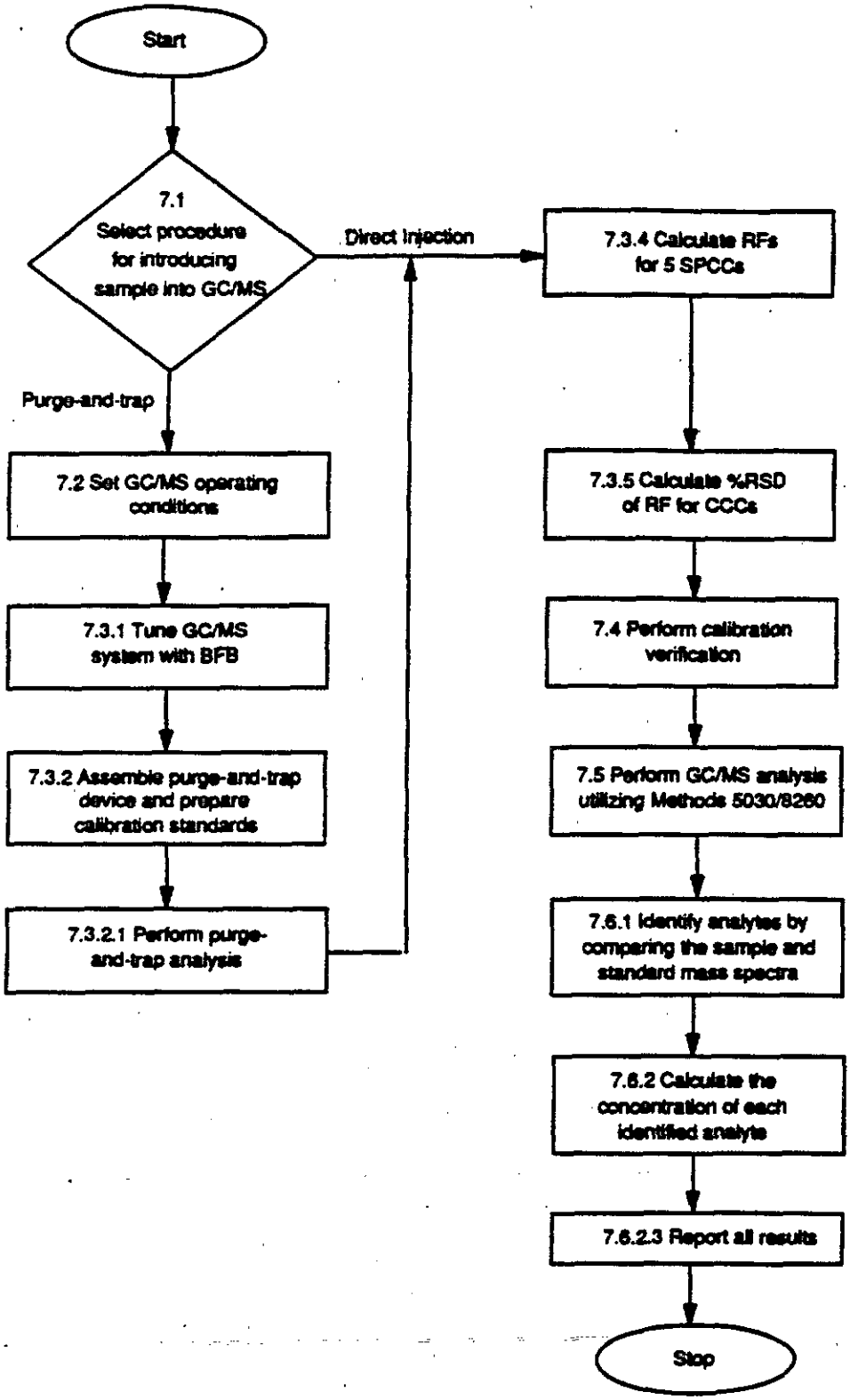


FIGURE 9.
LOW SOILS IMPINGER




Start
7.1
Select procedure for introducing sample into GC/MS
Direct Injection
Purge-and-trap
7.3.4 Calculate RFs for 5 SPCCs
7.2 Set GC/MS operating conditions
7.3.5 Calculate %RSD of RF for CCCs
7.3.1 Tune GC/MS system with BFB
7.4 Perform calibration verification
7.3.2 Assemble purge-and-trap device and prepare calibration standards
7.5 Perform GC/MS analysis utilizing Methods 5030/8260
7.3.2.1 Perform purge-and-trap analysis
7.6.1 Identify analytes by comparing the sample and standard mass spectra
7.6.2 Calculate the concentration of each identified analyte
7.6.2.3 Report all results
Stop

Appendix B
Data Management Plan

Final
Data Management Plan
Middletown Airfield NPL Site
Harrisburg, Pennsylvania

Under Contract with
U.S. Army Corps of Engineers
215 N. 17th Street
Omaha, Nebraska 68102-4978

Prepared for:
Air Force Regional Compliance Office
77 Forsyth Street, SW., Suite 295
Atlanta, Georgia 30335-6801

1 July 1994

Prepared by
Environmental Resources Management, Inc.
855 Springdale Drive
Exton, Pennsylvania 19341

TABLE OF CONTENTS

1.0 INTRODUCTION

This Draft Technical Data Management Plan describes the objectives and approach for data management that will be applied during the course of the investigation of the Middletown Airfield Site, Middletown, PA. The plan is an inherent part of the Work Plan for the investigation. The plan includes appendices relating to the aerial survey, the electronic library, and procedures for collecting and requesting data, which will be completed after review of the Draft by the U. S. Army Corps of Engineers (ACE).

A structured approach will be applied for managing data in support of the Middletown Airfield Supplemental Studies project. This approach employs procedures that are consistent with achieving high quality information products that will be used to support the decisions to be made throughout the project. The Data Management Objectives and the Scope of the Data Management Plan are described below.

1.1 TECHNICAL DATA MANAGEMENT OBJECTIVES

The Data Management Objectives for the Middletown Airfield Supplemental Studeie project are based on the Data Management Requirements defined in Appendix E of the Scope of Work for the Middletown project. These requirements are provided as Appendix A to this Document. The objectives for data management associated with the Middletown Airfield Site are:

- Employ standardized data structures for entering historical data and data from new field investigations;
- Utilize a centralized Project Database to store all data for use in conducting analyses to support the site investigation;
- Implement project standards for contractor analytical laboratories to facilitate transfer of laboratory analytical data into the Project Database;
- Utilize the ERM electronic network to transfer data to the Data Administrator;

- Utilize aerial survey data to facilitate the development of digitized base maps and site topographic files;
- Provide high quality graphical and tabular information products to project team members in a timely manner;
- Provide access to the data electronically, as required to support timely preparation of information products;
- Provide electronic data and map files to the ACE for viewing with Arc/INFO GIS software;
- Archive the results of the investigation in a manner that facilitates use in subsequent site remediation activities.

1.2 *SCOPE OF THE DATA MANAGEMENT PLAN*

Technical and administrative data and information of several types will be collected and used during the investigation. This plan relates to the collection, processing, and presentation of engineering and scientific technical information including maps and site drawings and associated data describing site conditions.

1.3 *DATA MANAGEMENT PLAN SUMMARY*

This Technical Data Management Plan describes the approach that will be applied by ERM for managing data throughout the investigation. The following items are addressed in the Plan.

- Staff Responsibilities
- Base Mapping
- Database Structure
- Historical Data from Previous Investigations
- Laboratory Analytical Results
- Field Data
- Geophysical Surveys
- Data Flow and Data Status Reporting
- Application of Geographic Information System (GIS)

- Images and Photographs
- Preparation of Information Products
- Quality Assurance
- Data Administration, Control, and Access
- Maintenance of the Data Management Plan
- Training Staff in Use of the Database

2.0 *DATA MANAGEMENT STAFF RESPONSIBILITIES*

Specific responsibilities are defined for all participants in the data management activities during the investigation. The project team members who participate in collection and use of the data have an important role in the data management process, and must become familiar with the procedures that will be used during the project.

Figure 2-1 illustrates the organizational structure of the Data Management activities for the project. The following data management responsibilities are defined::

- Project Manager - responsible for providing direction to the Data Management Coordinator concerning overall project schedule, priorities, deliverables, and emerging needs;
- Data Management Coordinator - has overall responsibility for data management activities, and is responsible to the Project Manager for setting priorities, assigning staff, and controlling schedule and costs for data management activities, and for defining tasks required to prepare information products in support of project needs;
- Data Administrator - is responsible for loading of data into the database, for maintenance of the database and the electronic library, for providing status reports concerning data quantities and quality, for preparing product specifications and information products in accordance with specifications, and for making the database accessible to project personnel; coordinates with the Project Manager in the absence of the Data Management Coordinator;
- Laboratory Quality Assurance Administrator - is responsible for accepting chemistry data files and data packages from the Contractor Laboratory and from the FAST Unit, for assigning Quality Assurance chemists, submitting validated chemistry data files to the Data Administrator, and updating the data status tracking system on the ERM File Server;
- FAST Manager - is responsible for assuring that hard copy reports to support field activities, and that electronic files are submitted to the Laboratory QA Coordinator from the ERM Field Analytical Services Technology mobile analytical unit;

- FAST Field Chemists - are responsible for preparing hard copy reports to support field activities, and for submitting electronic files to the Laboratory QA Coordinator from the ERM Field Analytical Services Technology mobile analytical unit;
- Programmer/Analysts - develop information products from the database consisting of tables, graphs, and summary statistics in accordance with project requirements under the direction of the Data Management Coordinator;
- CAD/GIS Analysts - prepare maps, drawings, and composite drawing/database graphics in accordance with requests from project team members under the direction of the Data Management Coordinator;
- Clerical Staff - key enter data and perform data administration tasks under the supervision of the Data Administrator;
- Project Scientists and Engineers - collect data and request information products in accordance with the data management standards and procedures of this plan.

Data Management Organization

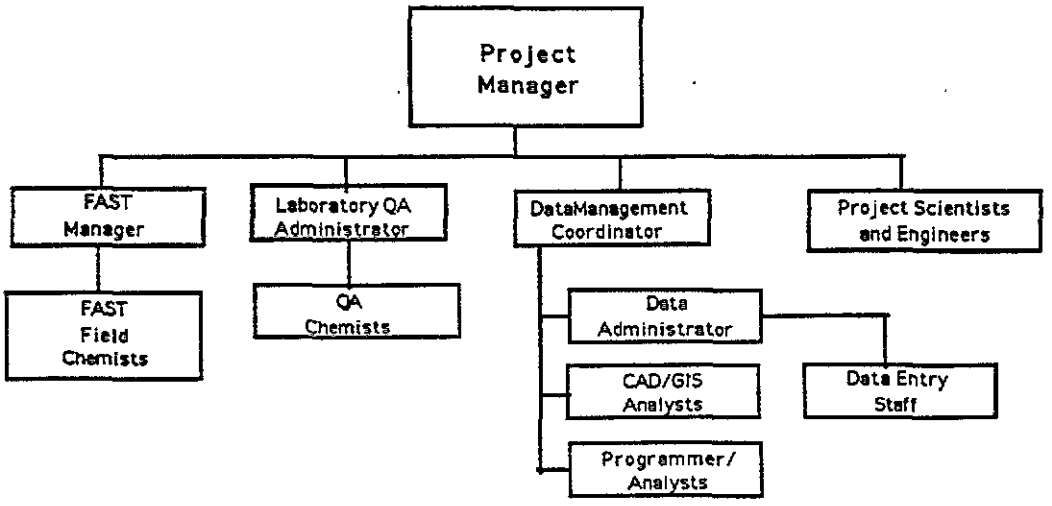


Figure 2-1

3.0 *BASE MAPPING AND SITE DRAWINGS*

This section describes the development of a Base Map for the Middletown Airfield site that will be applied to the investigation activities.

3.1 *AERIAL SURVEY AND DIGITIZED FILES*

High quality base maps are essential to the effective conduct of the investigation activities. Base mapping for the Middletown Airfield Site will be based on an aerial survey conducted during April, 1993 by Aerial Data Reduction Associates, Inc. (ADR). A set of aerial photos taken at a scale of 1 inch = 500. ft. have been used to create a composite index of photos for Swatara Township at a scale of 1 inch = 2,000 ft. These encompass the area of interest included in the Middletown Airfield. A subset of these photographs will be used to prepare base maps for the site.

The aerial photographs will be used to produce a digitized drawing file for the Middletown Airfield site. The extent of the area to be included and the specifications for producing digitized files will be defined by the Data Management Coordinator with guidance from the Project Manager. A written specification will be submitted to ADR for deliverable products required to support the Work Plan Document and the technical activities associated with the site investigation. A copy of the specification will be submitted to the ACE Project Manager for the ERM Contract. Deliverables will include digitized files and hard copy proof maps. A copy of the ADR specification is included as Appendix B to this Data Management Plan.

3.2 *WORK PLAN SITE DRAWINGS*

After receipt of the drawing files, a quality assurance step will be conducted to compare the digitized files with the proof drawing submitted by ADR. After the files have been reviewed, comments will be provided to ADR concerning revisions or modifications that may be required. A written specification will be provided to ADR for any modifications that are considered to be essential to the long term use of the files during the site investigation.

After a quality assured drawing file has been established, the Data Management Coordinator will coordinate with the Project Manager and the CAD/GIS Analyst assigned to the project to define specific map hard copy drawings. The CAD/GIS Analyst will prepare map-based information products for the Work Plan. These will consist of an overall site drawing at a scale 1 inch = 2,000 ft. and other drawings at higher resolution to identify specific site investigation areas (Operable Units) and other features of interest.

The base maps files will be submitted in draft format to the Project Manager for review and comment. Revisions based on this review will be made by the CAD/GIS Analyst, after which final information product deliverable hard copy drawings will be submitted to the Project Manager for use with the Work Plan. A copy of the site drawing file will also be installed in the Project GIS for use in preparing further information products.

As an alternative, and for preparation of the Draft Work Plan, a drawing currently available in AutoCAD and DXF format is available from R. E. Wright Associates, Inc. This file is a composite CAD drawing and a DLG file developed from USGS electronic Quad maps. A quote has been requested for this CAD file. This file may be used as a temporary base map for the site until the digitized files are available from ADR.

3.3 *FINAL SITE DRAWINGS*

After completing the base map files for the Work Plan, ADR will complete the photogrammetry process, including other data layers and site detail needed during the field activities. A subsequent deliverable by ADR will be provided, including the specified drawing elements. This file and the proof copy drawing will undergo a quality assurance step by the CAD/GIS Analyst, and will be revised if necessary, in accordance with written specifications provide by the Data Management Coordinator. Final drawing files will be delivered by ADR and will be installed in the Project CAD drawing file for use in subsequent steps of the project.

The CAD/GIS Analyst will maintain a library of drawing files (Middletown Airfield Site Electronic Drawing Library) to be used during the course of the project. This library will be maintained in accordance with ERM drawing management procedures. These procedures for

maintenance of the Middletown Airfield Site Electronic Drawing Library will be summarized by the Data Management Coordinator and Data Administrator and included in Appendix C to the Data Management Plan.

3.4 *OTHER MAP FILES*

The Site Engineer for the PADOT Bureau of Aviation at the Harrisburg International Airport (HIA) maintains a set of drawings that were prepared in 1983. An index map at scale 1"= 400' and 38 sheets are available at a scale of 1 inch = 50 ft. The drawings include:

- Planimetrics
- Topography at 1 ft. intervals
- Water lines
- Storm water
- Sanitary sewers
- Primary and secondary electric power
- Fire alarms
- Navigation aids

These drawings are for the airport area, and do not include the north industrial area and other off-airport locations where sampling will be conducted. Two sets of drawings are available: 1972 drawings updated in 1977, and another update in 1980. These drawings and associated aerial photos have some value to the project in establishing earlier site conditions and in designing sampling plans and in assuring that there is no damage to active sub-surface infrastructure.

Finally, an Airport Master Plan was developed in 1980 resulting in drawings at a scale of 1"=200 ' and 1"=300'. There are 12 drawings in this set. These will be ordered from the PADOT Bureau of Aviation.

The Data Management Coordinator, with the guidance of the Corps of Engineers and the Project Manager, has contacted the PADOT Bureau of Aviation at the Harrisburg Airport and has evaluated the extent and nature of these drawings. A meeting was held at the Airport Engineer's office to review the available drawings. A letter request was prepared for

the Bureau of Aviation and copies of available drawings are being prepared for use in conducting the investigation.

These drawings are not available in digitized format. If there are features on these drawings that serve the purposes of the site investigation, a task will be defined to digitize these features and include them within the Middletown Airfield Site Drawing Library for the project.

4.0 *DATABASE STRUCTURE*

A computerized technical database called the Middletown Airfield Site Database will be used to store and access all technical data associated with the Middletown Airfield Site Project. The database structure has been designed specifically for site investigation data management. A relational database management system is used to manage the data. The following hierarchy defines the data tables that will be included within the Middletown Airfield Site Database.

- Middletown Airfield Site
    1. Area
    2. Location
        - 2.1. Sample
            - 2.1.1. Chemical/Physical Test Results
            - 2.1.2. Quality Control Results
        - 2.2. Boring Completion
            - 2.2.1 Borehole Interval
                - 2.2.1.1 Borehole Stratigraphy
            - 2.2.2. Well Construction Interval
                - 2.2.2.1. Well Construction Parameters
        - 2.3 . Borehole Geophysics
            - 2.3.1 Borehole Geophysics Interval
        - 2.4. Ground water
    3. Parameter

Each of the above tables includes data elements that will be coded into fields having specified numeric or alphanumeric contents. The tables include key fields that define relationships through which data can be extracted efficiently, and which also optimize the overall size of the database.

In addition to the above tables, a set of Valid Value Tables will be maintained to support Quality Assurance of the database. These tables will not be accessible to users, and will be maintained by the Data Administrator, as discussed in the Quality Assurance section, below.

The table structure and data field definitions and User's Guide for the Middletown Airfield Site Database will be made available to project participants for use in planning field data collection activities.

5.0 *HISTORICAL DATA FROM PREVIOUS INVESTIGATIONS*

Historic site investigation data is available in hard copy site reports and in digitized files from previous investigations of the Middletown Airfield Site. A graphical visualization file based on these data sets is also being prepared by an EPA contractor using the Dynamic Graphics Earthvision software. EPA has agreed to provide existing files, which are available in a number of different spreadsheet and database formats, and the Earthvision graphical files to the U. S. Army Corps of Engineers for use by the ERM Project Team. The Data Management Coordinator will, with the assistance of EPA and the Corps of Engineers Project Manager, request hard copy information products, data files, and graphics files. If it is considered to be of benefit to the site investigation by the Project Manager, Dynamic Graphics will be contacted to provide additional information products as a subcontractor, using site data obtained by ERM.

Contacts with the PADOT Bureau of Aviation have identified a U. S. Air Force Master Plan for Olmsted Air Force Base developed in 1956. This document has been obtained and submitted to the ERM Project Manager. It includes drawings, a listing of buildings and their uses, property tract descriptions, and other planning information that may be useful during the investigation. Some of the contents of this document, both graphics and data, may be digitized for use in preparing information products during the course of the investigation, at the discretion of the Project Manager.

It is not expected that the full set of data collected in prior investigations will be included in the Middletown Airfield Site Database. It is expected that some of this data may be used for comparative purposes during the course of the investigation activities to provide guidance into sampling plans and field investigations. Since the structure of files developed by others during prior investigation does not agree with the Middletown Airfield Site Database , it would be necessary to modify the selected data sets before installing them into the Middletown Airfield Site Database. Historical data will only be loaded after coordination with the Project Manager. Historical data in electronic format may also be used to prepare information products without actually loading the files into the Middletown Airfield Site Database.

The Data Management Coordinator will conduct a review of the historical data files that are made available to the project team by EPA, including both digitized data and the hard copy reports. With the guidance of the Project Manager, a decision will be made concerning which of these data elements will be installed into the Middletown Airfield Site Database.. Those files not stored in the Middletown Airfield Site Database will be maintained separately in the file structure under which they have been obtained. A task will be defined to optimize the approach for having access to these files (hard copy for use as needed, electronic format in the structure currently available, or revision and loading into the Middletown Airfield Site Database) so that are available as needed to support the development of information products for the site investigation.

6.0 LABORATORY ANALYTICAL RESULTS

During the course of Middletown Airfield project, a large quantity of laboratory analytical results are expected. Chemical analytical results will be provided by subcontractor analytical laboratories and by the ERM Field Analytical Services Technology (FAST) Mobile Unit. Data loading standards will be employed to facilitate the transfer of analytical data into the database.

6.1 ANALYTICAL LABORATORIES

For data analyzed by contractor laboratories, the approach for dealing with analytical data is defined as follows:

- Sampling Plans will be reviewed by the Data Management Coordinator prior to field activities during which samples are collected.
- Sample Location coding protocols will be defined and sample locations will be identified and stored in the database, to be consistent with the Sampling Plan.
- A Sample Tracking database will be used to log the status of each round or batch of field sampling and to provide reports to the Project Manager concerning status.
- Sample Identification codes will be assigned in conjunction with the Project Manager and the Laboratory Quality Assurance Manager.
- Subcontractor Analytical Laboratories will be provided with specifications for electronic deliverables (diskettes) that are to accompany data packages submitted to ERM containing analytical results.
- A test diskette will be requested from each laboratory prior to transmittal of actual data, in order to conduct a test of data loading for that laboratory, and to assure that the specification has been interpreted correctly.
- Diskettes containing laboratory analytical results will be submitted to the Laboratory Quality Assurance Manager, accompanying each data package.

- The Laboratory Quality Assurance Manager will prepare hits tables and final validated data tables, including value qualifiers, for the Middletown Airfield Site Database.
- A diskette copy of the validated data will be sent to the Data Administrator and batch loaded into the Middletown Airfield Site Database. Batch loading will include automated Quality Assurance procedures.
- A Database Status Tracking System will be used to track the status of laboratory samples.
- The Laboratory Results will be made available within the Middletown Airfield Site Database by the Data Administrator for use by project staff.

6.2 *FIELD ANALYTICAL SERVICES TECHNOLOGY (FAST)*

The ERM Field Analytical Services Technology (FAST) Unit will be used to support sampling of soils borings, soil gas, water, and sediments through field screening activities. GC and GC/MS units will be used to produce sample concentration results in support of the Remedial Investigation. A preliminary screening effort will be conducted, followed by ongoing support to the full-scale sampling and analysis program.

The FAST results will be provided to field teams in hard copy format for use in real-time decision-making concerning the sampling program. After returning from the field, a diskette formatted in accordance with specifications developed among FAST, Laboratory QA, and Data Management personnel will be developed. The data will be submitted to the Laboratory QA Coordinator, who will prepare a QA report and submit the diskette to the Data Administrator. The Data Administrator will maintain a file of FAST data results. At the request of the Project Manager, data on these diskettes will be loaded into the Middletown Airfield Site Site Database to support the development of information products.

7.0 *FIELD DATA*

Field Data Forms describing site geology and environmental conditions have been defined by the ACE in the Scope of Services. A copy of the form to be used for drilling logs is provided in Appendix D. The completed copies will be returned by the field geologist or scientist taking the samples and will be submitted to the ACE as specified in the Scope of Work.

The field drilling results will be analyzed by the a geologist to provide an interpreted version of the drilling logs, identifying distinct layers of differing stratigraphic materials. Data Entry forms compatible with the Middletown Airfield Site Database tables will be used to record the interpreted data following field investigations. These forms will be used for data entry into the Middletown Airfield Site Database.

Field data entry will be accomplished through two different procedures:

- EXCEL spreadsheet forms structured to be compatible with the Middletown AirfieldSite Database tables will be made available to project field teams. The forms provide an efficient means for allowing field personnel to create electronic files without need for accessing the Middletown Airfield Site Database directly. The completed tables will be transmitted to the Data Administrator via electronic mail. The Data Administrator will assign a standard file name to each spreadsheet and will maintain a library of spreadsheet submittals from field team members.
- FoxPro data entry screens for use by field personnel to enter data from the field investigations and perform preliminary QA on the data. These database tables will be entered into the Middletown Airfield Site Database.

The Middletown Airfield Site Database also stores other data associated with field investigations (e.g., ground water elevations, environmental observations, and borehole geophysics). Middletown Airfield Site Database data forms will be filled out by field teams. to support data entry using EXCEL or FoxPro screens to code the results. The files will be batch loaded into the Middletown Airfield Site Database using quality assurance procedures to reject records that have not met with the standards. These

records will be returned to the originator for revision and resubmitted for batch locating. The Middletown Airfield Site Database will be used to produce a hard copy report of the field data for the originator. The originator will review the report, designate appropriate revisions, and then return the marked-up copy to the Data Administrator, who will edit the Middletown Airfield Site Database accordingly.

As an alternative to this Quality Assurance procedure, project staff may be provided with access to the Middletown Airfield Site Database to browse the tables and compare them with their hard copy coding forms, and identify any inconsistencies that may result from key entry. The Data Administrator will be notified if the field data is acceptable, and will be provided with marked up copies of coding forms to identify corrections to the tables. The process will be repeated until the data form and the table contents are consistent.

8.0 DATA FLOW AND STATUS REPORTING

The orderly flow of data and the reporting of Middletown Airfield Site Database status during the project are essential components of the data management process. Laboratory analytical data and field geological data comprise the two largest components of the database, with the laboratory data constituting the greater of these two. The data flow and status reporting process steps are illustrated in Figure 8-1. Each of the components of the process are designated by alphanumeric codes identified on the figure and are described below.

8.1 WORK PLAN AND QUALITY ASSURANCE PLAN

The Project Manager (1) is responsible for preparing the Work Plan and Quality Assurance Program Plan (QAPP) (1a), defining the overall Site Investigation Procedures. The Work Plan describes the Sampling and Analysis Plan (SAP) for drilling, well logs, geophysics, and soil boring. Sampling Plans for chemical analyses are defined in Table 3-1 of the Work Plan.. These plans provide the Data Administrator with quantitative information concerning the expected sampling requirements for the project, including:

- Number of wells and expected locations
- Number of soil borings and expected locations
- Geological variables to be recorded
- Number of analytical samples
- Laboratory analyses to be conducted
- Sample locations codes
- Sample types/media

These planning elements provide the Data Administrator with a preliminary estimate of the expected database contents. They constitute a data shell that serves as a receptor for the actual data that will be received once the field samples have been collected and analyzed or interpreted. The shell contains completed data fields containing sample location codes and related information describing the samples before they have been

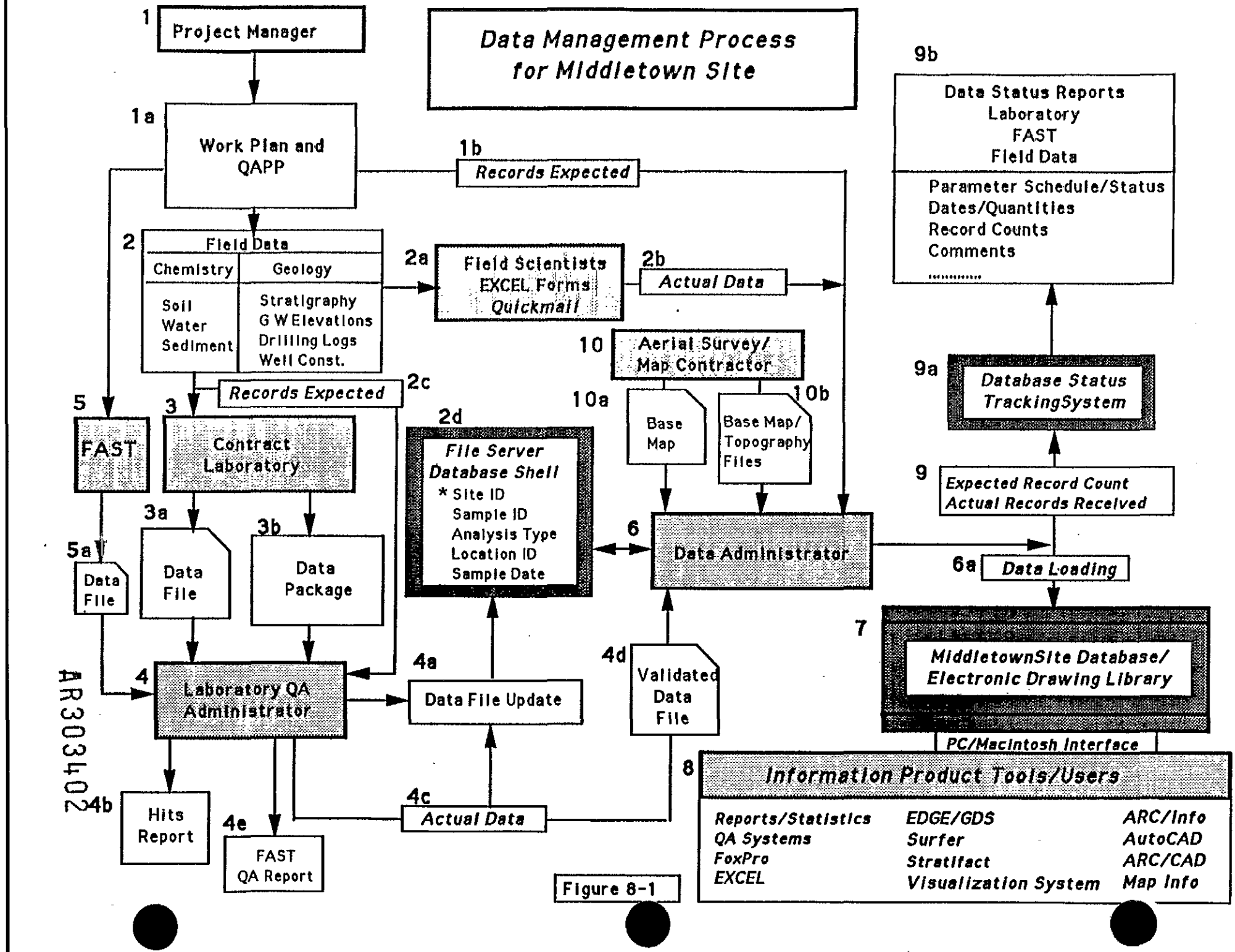

Data Management Process for Middletown Site
1 Project Manager
1a Work Plan and QAPP
1b Records Expected
2 Field Data
Chemistry
Soil
Water
Sediment
Geology
Stratigraphy
G W Elevations
Drilling Logs
Well Const.
2a Field Scientists EXCEL Forms Quickmail
2b Actual Data
2c Records Expected
2d File Server Database Shell
* Site ID
Sample ID
Analysis Type
Location ID
Sample Date
3 Contract Laboratory
3a Data File
3b Data Package
4 Laboratory QA Administrator
4a Data File Update
4b Hits Report
4c Actual Data
4d Validated Data File
4e FAST QA Report
5 FAST
5a Data File
6 Data Administrator
6a Data Loading
7 MiddletownSite Database/ Electronic Drawing Library
PC/Macintosh Interface
8 Information Product Tools/Users
Reports/Statistics
QA Systems
FoxPro
EXCEL
EDGE/GDS
Surfer
Stratifact
Visualization System
ARC/Info
AutoCAD
ARC/CAD
Map Info
9 Expected Record Count Actual Records Received
9a Database Status TrackingSystem
9b Data Status Reports
Laboratory
FAST
Field Data
Parameter Schedule/Status
Dates/Quantities
Record Counts
Comments
10 Aerial Survey/ Map Contractor
10a Base Map
10b Base Map/ Topography Files
AR303402

Figure 8-1

taken, which is stored in the Middletown Airfield Site Database. The entry of this data is the responsibility of the Data Administrator. This data set serves as a basis for estimating the Records Expected (1b) in the Middletown Airfield Site Database.

8.2 *FIELD DATA COLLECTION*

Field data (2) takes two different paths: field geology and environmental data; and chemistry data, requiring analysis by the contractor laboratory.

8.2.1 *Field Geology and Environmental Data*

Field samples (drilling logs, ground water elevations, etc.) will be recorded in field log books and converted into Middletown Airfield Site Database format by keying them into EXCEL Spreadsheet forms (2a) that are compatible with the Middletown Airfield Site Database. The EXCEL file names for these data sets will be defined by the Data Administrator to facilitate data exchange. The files (2b) will be transferred over electronic mail or via diskette to the Data Administrator, who will be responsible for assuring that the data is loaded (5a) into the Middletown Airfield Site Database (6). When data is loaded into the Middletown Airfield Site Database, the Record Counts (7) will be transferred to the Database Status Tracking System (7a) to produce Field Geology Status Reports (7b).

8.2.2 *Chemistry Data*

When chemistry samples are taken, a traffic form will be completed by the field personnel responsible for the sample, and a copy of the traffic report (2c) will be submitted to the Laboratory Quality Assurance Administrator. The sample identity and expected analyses will be entered onto the Middletown Airfield Site ERM File Server (2d), which identifies the chemical samples taken for the project. The Data Administrator (6)will access the Middletown Airfield Site File Server and update the Middletown Airfield Site Database Status Table with the Records Expected (2e) based on field sampling activity, which will differ from the Expected Records in the Work Plan by reflecting actual field decisions concerning sampling. The two data sets (1b) and (2c) will be used within the Database Status Tracking System (9a) to develop a Data Status Report (9b) for the Project Manager describing the actual data expectations and the variances from the Work Plan.

Laboratory samples transferred from the field to the Analytical Laboratory (3) will be analyzed in accordance with specifications provided by the Laboratory Quality Assurance Administrator. On completion of analyses, data files on diskettes (3a), formatted in accordance with specifications developed by the Laboratory Quality Assurance Administrator and the Data Administrator, will be delivered by the Analytical Laboratory to the Laboratory Quality Assurance Administrator (4) for validation. Hard copy Data Packages (3b) accompany these deliverables. The Laboratory Quality Assurance Administrator will update the data status table on the File Server (4a). This file will be used to identify the Actual Records received from the laboratory, and to prepare the Data Administrator for the records that will be available after validation.

After the data has been validated by the Laboratory Quality Assurance Administrator, a Hits Report (4b) will be prepared. A validated data file (4d) will be delivered to the Data Administrator (6) and the File Server will again be updated (4c). This file will be loaded (6a) into the Middletown Airfield Site Database (6) to provide new data sets for use by project personnel. After data has been loaded, the status reporting process (9), (9a), (9b) will be completed to provide the Project Manager with current database status information.

8.2.3 *FAST Data*

The Work Plan and QAPP (1a) will define the expected sampling activities of the FAST Unit(5). FAST analytical results will be used in the field in hard copy reports to support sampling programs. After completion of field activities, a diskette containing the FAST results (5a) will be submitted by the FAST Chemist to the Laboratory QA Administrator. The format of this file will be defined prior to initiating field activities. The Laboratory QA Administrator will prepare a FAST QA report, and will submit a diskette of results (4d) to the Data Administrator. The format of the diskette will be the same as that used for Contractor Laboratory Analyses.

8.2.4 *Base Maps/Site Drawings*

To support the Work Plan, a base map has been acquired from R. E. Wright Associates, who is the Map Contractor (10) for this map product. This map file (10a) was delivered by R. E. Wright in AutoCAD and DXF format for use in preparing the base map deliverables for the Work Plan.

This file was submitted to the Data Administrator and has been used in conjunction with requirements defined by the Project Manager to prepare hard copy figures for the Work Plan. It is being used in conjunction with hard copy maps obtained from the PA DOT Bureau of Aviation for the airport portion of the site (off-airport data is not available from the Bureau of Aviation). This map is not of appropriate quality for the project, since its accuracy is not verifiable, it contains no topography, and it is of limited detail. After the Aerial Survey firm (ADR) has been contracted, a new set of current base map files (10b) will be received and these will be loaded into the Project Database (7) for further use during the course of the project.

9.0 *GEOGRAPHIC INFORMATION SYSTEM*

A Geographic Information System (GIS) and Computer Aided Drafting (CAD) system will be used to conduct data analysis and to prepare information products during the course of the investigation. ERM will employ its in-house GIS capabilities to provide this support. ARC/CAD and ERM's GDS-based *EDGE* will be linked to the Middletown Airfield Site Database for the purpose of preparing maps and drawings in response to project staff requests. These systems support the development of cross-sections, volume computations, contouring, and other functions to relate field data to spatial locations and to provide graphical representations of data.

The Stratifact software for geological data interpretation is currently available at ERM, and will be available to prepare fence diagrams and stratigraphic displays. Dynamic Graphics Earthvision or other high level visualization software will be applied under sub-contract, when appropriate, to provide increased visibility into site conditions at the request of the Project Manager.

Use of GIS data analysis tools will be achieved through creation of files that are passed on to these tools (e.g., *EDGE*, Earthvision, Stratifact, etc.). Data sets for these tools will be obtained through preparation of information product request forms.

10.0 IMAGES AND PHOTOGRAPHS

In addition to digitized data and drawings, access to electronically imaged data may be used to support site investigation activities. These would include:

- Photographs of site conditions, topographic features, contaminated areas, or other aspects of the site that are useful in conveying information to the project team; and
- Digital orthophotos that can be used as overlays onto site drawings.

The Data Management Coordinator will advise the Project Manager concerning the application of imaging technology to the project. Scanned images accessible via menus to provide project staff with quick access to information that might otherwise be stored in file cabinets or on book shelves. The Data Management Coordinator will coordinate with the Project Manager to define specific requirements for:

- providing digital orthophotos that can be stored in the Middletown Airfield Site Electronic Drawing Library; and
- providing network access to electronic images or documents to support project activities.

If such capabilities provide efficiency and productivity in meeting long-term project objectives, the scope of the activity will be defined and submitted to the ACE Project Manager for consideration.

11.0 INFORMATION PRODUCTS

Information products of several types will be produced for use by project teams during the investigation. The following types of products are included:

- Maps and drawing including planimetric and topographic features as overlays;
- Maps and drawings showing chemical results, chemical concentration contours, geophysical survey overlays, ground water, and other field data;
- Cross-sections and three dimensional views of topography and contaminated zones;
- Volume computations of contaminated zones and excavations.
- Tables containing raw data and summary statistics; and
- Graphical data displays including histograms, bar charts, pie charts, time series, and trend lines.

11.1 INFORMATION PRODUCT REQUESTS

There are six Investigation Areas as well as a number of other sampling locations where information products will be prepared, such as streams, river, and production wells.

Information products of the following types can be requested by project team members:

- Hard copy reports or graphics;
- Electronic files that can be accessed and viewed over the ERM network, when access hardware and software tools are available;
- Electronic files containing data or graphics that can be downloaded to the requester for use with other software tools.

To facilitate the preparation of information products the following procedures will be applied:

- Standardized site views will be prepared in advance, using the planimetric and topographic files to illustrate the whole site or selected areas that relate to specific environmental issues. These views will be stored as drawings in the Middletown Airfield Site Electronic Drawing Library.
- Standardized table formats to display analytical results (hits tables, statistics) will also established in advance of product requests.
- An Information Product Request Form (Appendix E) will be used to specify the product requirements (e.g., data sets, site views, graphical displays, color selections, table formats, date required, etc.). The Request Form will also be available via electronic mail and can be submitted electronically.
- The request will be transmitted to the Data Administrator by the Requester using electronic mail or by hard copy
- The Data Management Coordinator will coordinate with the Data Administrator daily to review information product requests and to assign staff to the outstanding requests
- The information product request will be reviewed and clarified with the requester and logged for delivery. A Programmer/Analyst or CAD/GIS Analyst is assigned to the preparation of the draft information product.
- The requester will be notified via electronic mail that the product has been completed. A hard copy of the product will be submitted to the requester and/or the names and locations of file(s) relating to the request will be identified.
- If the product is electronic, the requester will be provided with a diskette or access the file over the ERM computer network.
- The requester will identify the product as acceptable, or will specify changes to the product.
- Final information products (maps, drawings, graphs, tables) will be provided to the requester (electronic or hard copy).

11.2 *DATABASE ACCESS*

At the request of the Project Manager, project staff may be provided with access to the Middletown Airfield Site Database over the ERM network to browse data tables, review data, submit queries, and prepare reports based on the database contents. Project staff will not have write or change access to the database, and will not be permitted to change the database contents. Staff may also be provided with access to map graphics, and drawings over the network to review information products that result from requests, if this approach is cost-effective.

Controlled access to the Middletown Airfield Site Database and GIS by Corps of Engineers and other authorized government personnel may also be provided during the course of the project. The Data Management Coordinator will define the requirements (hardware/software/ telecommunications) and associated costs for this capability, and will make arrangements for installing the necessary hardware and software to provide such access when benefits to the project can accrue. Such access may include the same capabilities as those available to project team personnel, as well as others that are more suited to remote telecommunications.

11.3 *DELIVERY OF DATA FILES AND DRAWINGS TO THE U. S. ARMY CORPS OF ENGINEERS*

The data files and drawings developed during the course of the Middletown project will be made available to the ACE in electronic format. The Data Management Coordinator will coordinate with the Corps of Engineers concerning media and file specifications for the submission. A task will be defined to prepare database and graphical files in ARC/Info format for submission to the Corps of Engineers.

11.4 *DELIVERY OF DATA FILES AND DRAWINGS TO THE U. S. ENVIRONMENTAL PROTECTION AGENCY*

The data files and drawings developed during the course of the Middletown investigation project will be made available to the U. S. EPA in electronic format. The Data Management Coordinator will coordinate with the EPA concerning media and file specifications for the submission.

A task will be defined to prepare database and graphical files for submission to EPA. The submission will be coordinated with the Project Manager and with the approval of the Corps of Engineers.

12.0 *QUALITY ASSURANCE*

The large quantities of data associated with the Middletown Airfield Supplemental Studies project impose severe demands on project staff in assuring that results of analyses are based on accurate representations of the available information. Quality Assurance procedures will be applied relating to the management of data in order to minimize data errors. These include:

- Hard copy base maps provided by aerial surveyors will be compared with the hard copy created from the digital files provided by the same contractor before digital files are released for use within the Middletown Electronic Drawing Library.
- Valid Value Tables will be established for key data elements (e.g., sampling locations, chemical parameters, operable units) so that data orphans are not entered into the database; attempts to enter data for these fields will be rejected if they do not match the Valid Value list for the data element;
- Automated procedures will be employed during batch loading to check numerical fields and assure that they are within allowable thresholds (e.g., positive values or threshold levels for chemical concentrations);
- Hard copy data packages submitted by analytical laboratory contractors will be compared with formatted reports that are prepared using the digital files submitted by the contractors on diskettes before the data is released within the Middletown Airfield Site Database for access by project staff:
- Laboratory analytical data will be validated by the Laboratory Quality Assurance Administrator, and only validated data will be loaded into the Middletown Airfield Site Database by the Data Administrator;
- Field personnel who provide source data for the Middletown Airfield Site Database will review their submissions after electronic versions have been created, comparing them with source documents, in coordination with the Data Administrator;

- Laboratory and field geology data that has not been validated will not be accessible to project staff from the Middletown Airfield Site Database;
- The Data Administrator will have responsibility for the quantity and quality of data in the Middletown Airfield Site Database; and
- Information products prepared by the Data Administrator or by Programmer/Analysts or CAD/GIS Analysts will be designated as Draft Products, and are viewed as Draft Products by requesters until they have been reviewed by the requester. The Draft Product designation will be retained until the Project Manager has reviewed the product and released it for general use, or for inclusion in a project report or deliverable.

13.0 DATA ADMINISTRATION, CONTROL, AND ACCESS

The Data Manager will be responsible for controlling the loading of data and the access to the Middletown Airfield Site Database by users and product requesters. The following procedures will apply to data control and access:

- Valid Values for sampling locations, sample ID codes, etc. will be established by the Data Administrator and in conjunction with the Data Management Coordinator and Project Manager, after review of the Sampling Plan. Valid Values will be entered into the database and will be accessible to the Data Administrator, but not to users.
- Data Forms compatible with Middletown Airfield Site Database Database Table formats will be provided to the Project Manager by the Data Management Coordinator for use in coding field data.
- A Sample Tracking Database will be used by the Data Administrator to identify expected data arrival dates and quantities of analytical sample results in order to schedule resources for data turn-around.
- Originals of data entry forms will be submitted to the Data Administrator for use in key entering data into Middletown Airfield Site Database Tables; these forms will be filed by the Data Administrator as an archive of source data throughout the project.
- Copies of diskettes submitted by contractor laboratories will be filed by the Data Administrator as an archive of analytical data for the project.
- The Middletown Airfield Site Database for the project will reside on a computer for which access will be controlled and maintained by the Data Administrator.
- Record count summaries for each of the database tables will be maintained by the Data Administrator and reported to the Data Management Coordinator.
- The Middletown Airfield Site Database and GIS will be accessible to project staff having authorized access codes over the ERM network. The Data Administrator will be responsible for issuing and maintaining user access codes.

- Project staff may access the Middletown Airfield Site Database and GIS in Read Only mode to scroll through data, submit queries against the database, and produce menu-driven or self-generated output products.
- Data entry staff will have write access to the Middletown Airfield Site Database tables in order to enter data into the database.
- Information product requests will be processed by the Data Administrator and filed as an archive of project activity.
- The Data Administrator will create backup files for the Middletown Airfield Site Database weekly and store the files in a secure location that is different from the Middletown Airfield Site Database processor hard disk.
- The Data Administrator will maintain copies of information products produced for Requesters and create a portfolio of products to facilitate subsequent information product requests from other Requesters.

14.0 TRAINING

In order to support application of the procedures and information management systems described in this plan, a training program will be conducted for project personnel. Training will be conducted by the Data Management Coordinator, Data Administrator, and other personnel who have responsibilities for data management procedures described in this plan. Training of project personnel will include:

- Hardware/ Software/ Requirements for Database Access
  - Network Connectivity and Software
  - Us of Mac of PC for access
- Loading Data via Excel tables or FoxPro screens
  - Use of Data Entry Forms;
  - Use of Spreadsheet forms for batch data entry
  - Electronic transfer of data to the Data Administrator
  - Excel Requirements
  - Form Files
  - Naming files and transmitting over the network
  - Data Administrator loading procedure
- Access to the Middletown Airfield Site Database
  - Database Table Definitions
  - Data Dictionary describing each field;
  - Logging onto the Database
  - Using menu to find a specific form
  - Scrolling through the form
  - Making ad hoc queries
- Viewing Drawings and Data
  - Logging on
  - Using menus to produce graphics for site

- Requesting Information Products
  - Information Product Request Form
  - Using Quick mail to request a product
  - Data Administrator response to Product Request
  - Identifying the Information Product File for the Requester

15.0 DATA MANAGEMENT PLAN MAINTENANCE

This Data Management Plan has been documented for inclusion within the Work Plan for the Middletown investigation during the planning phase of the project. The procedures in this plan will be revised or modified as necessary to meet specific project requirements. The Plan will be maintained by the Data Management Coordinator who will coordinate with the Project Manager concerning any modifications that may occur during the course of the project.

The Data Management Plan will be distributed to project personnel who participate in the Middletown investigation. Project personnel are responsible for understanding its contents, and for applying the procedures in order to assure efficient flow of data and timely preparation of information products throughout the project duration.

16.0 DATA MANAGEMENT TASK BUDGETING AND CONTROL

The completion of the investigation requires a responsive management structure and organization that can address the project's needs for information products in a timely fashion. Furthermore, the budget that is available for data management must be allocated appropriately to address the uncertainty that is inherent to a remedial investigation. The Work Breakdown Structure for Data Management during the project is defined as follows:

1.0 Data Management Planning and Coordination

- 1.1 Planning and Procedures Documents
- 1.2 Data Entry Task Coordination
- 1.3 Information Product Specification and Coordination
- 1.4 Monthly Reporting

2.0 Data Entry and Quality Assurance

- 2.1 Data Management System Development
- 2.2 Key Entry and Validation
- 2.3 Batch Loading and Validation

3.0 Information Product Preparation

- 3.1 Information Product System Development
- 3.2 Database Products
- 3.3 GIS/CAD Products
- 3.4 ACE Deliverables

The Data Management Coordinator will allocate the budget to this WBS and review it with the Project Manager. After the allocation has been approved it will be used to control project activities. A monthly status of budgets and actual expenditures for each WBS item will be prepared for the Project Manager by the Data Management Coordinator.

Appendix A
General Data Management Requirement

APPENDIX A GENERAL DATA MANAGEMENT REQUIREMENT

This requirement is Appendix E of the Scope of Services for the Middletown Airfield Site.

Appendix B
Aerial Photography and Photogrammetry
Specification for Middletown Airfield

APPENDIX B AERIAL PHOTOGRAPHY AND PHOTOGRAMMETRY SPECIFICATION FOR MIDDLETOWN AIRFIELD

23 December 1993

1.0 General Requirement

This specification is for the preparation of base map files and hard copy products based on an aerial survey conducted by Aerial Data Reduction, Inc. (ADR) for the Swatara Township, PA area. A composite aerial photograph at a scale of 1 in. = 2,000 ft. has been provided to ERM by ADR describing the extent of the available aerial photos, which are at a scale of 1 in. = 500 ft The aerial photography was conducted on April 8 and 13, 1993. ADR is requested to provide quotes for the submission of maps and associated digitized data files to ERM based on this existing aerial survey.

ADR (the contractor) will provide aerial photographs, drawings, and digitized files representing both planimetric features, and two dimensional topography for Middletown Airport site located in Swatara Township, PA, and included within the extent of the referenced survey. The contractor will also provide digital drawing files including planimetric and natural features, and topographic contours for the site. In addition, a Digital Elevation Model of x,y,z locations describing the three dimensional topography for the site will be provided.

The site area is approximately 14,000 feet north/south by 18,000 feet east/west. The site and surrounding area are illustrated in the attached Figure 1, which is taken from the composite index aerial photo provided by ADR;, and Figure 2-5 from a previous investigation of the site.. A buffer of 200 ft. around the site property will be provided where photographs are available.

2.0 Coordinate System

The Pennsylvania State Plane Coordinate system will be used to represent the x,y coordinate values for planimetrics and topography. It may be necessary for the Contractor to revise the coordinate easting and northing values to a relative local origin, anticipated at this time to be south and west of the site (ERM will specify). This would result in reducing the

easting and northing coordinate values to a coordinate system that will be designated as the Site Coordinate System. This decision will be made prior to the initiation of work.

The contractor will identify land survey requirements, if any, ERM to ground truth data or to support the accuracy requirements specified. ERM will obtain records to identify the boundary of the site that will be investigated by ERM.

3.0 *Planimetric Features*

The planimetric features will be stored in layers, to include:

- Buildings and structures
- Tanks and Towers
- Paved and unpaved road edges
- Runways and taxiways
- Fence lines
- Property line
- Parking areas and Pads
- Surface hydrology
- Power lines
- Tree and forest areas
- Control Points
- Basins
- Major Drainage Areas
- Debris Piles
- Trailers
- Other features that are useful in designating the site.

4.0 *Topography*

A topography layer will be provided to represent contours of constant vertical elevation above MSL for the site. The contour interval will be 2 feet.

5.0 *Horizontal Accuracy*

Horizontal accuracy requirements for the planimetric features and for topographic contours are (+ -) 1 foot.

6.0 *Digital Elevations*

Digital values of elevation above mean sea level (MSL) for the site will be provided in reference to the Pennsylvania state plane coordinate system. The data will be provided as sets of points containing three values defining their easting, northing, and MSL elevation values. The easting and northing will be related to the appropriate reference origin. An appropriate number of horizontal and vertical control points will be included in order to provide accurate referencing to the state plane coordinate system.

The digital elevation model for the site will be capable of generating contours at an interval of two ft. to a guaranteed accuracy of (+ -) 1 foot. The gridding interval required for the Digital Elevation file will be defined by the contractor to achieve the stated accuracy requirement, and x,y values will be provided at regular intervals. The software and gridding algorithm used will be identified by the Contractor.

7.0 *Deliverables*

The following deliverable items will be provided by the Contractor to ERM offices in Exton, PA:

Preliminary Base Map

A draft base map hard copy at a scale of 1" = 200 feet with limited planimetrics, suitable for use in a project planning document, will be delivered by the Contractor to ERM by 21 January 1993. Digital files will be provided to ERM for use in testing data loading into its CAD/GIS systems.

Finished Base Map

A finished base map with all planimetric features will be delivered by the Contractor to ERM by 28 February 1993.

Digital Files

The digital files including planimetrics and topographic contours will be submitted on 3 1/2 in. diskettes at a density of 1.44 Mbytes in AutoCAD format or in a format that is agreed upon by the contractor and ERM. The diskette(s) will be accompanied by documentation describing the file contents, including file names, record layouts, and record counts, and by a hard copy map in standard engineering size containing the planimetrics and topographic features contained on the diskettes. Diskette deliveries will be documented by the contractor and will include

- Definition of software and version used to prepare each file;
- Definition of file names included on each diskette;
- Definition of each layer contained within each file;
- Definition of the file size for each file submitted;
- Label on each diskette relating it to the documentation; and
- Name and phone number of point of contact who will be available to answer questions concerning the files.

Contact Prints

The Contractor will submit to ERM 5 sets of double-weighted, 9-inch by 9-inch, high resolution, high contrast black and white contact prints, and one set of negatives of the aerial photographic coverage. One set of contact prints will be annotated with the ground control date.

8.0 Schedule

The schedule for completion of the project is defined as follows:

• Contract acceptance	5 January 1994
• Coordinate system origin decision	5 January 1994
• Draft base map	21 January 1994
• Final base map	28 February 1994
• Digitized files	28 February 1994
• Contact print	28 February 1994

Appendix C
Middletown Site Airfield Electronic Drawing Library

APPENDIX C MIDDLETOWN SITE AIRFIELD ELECTRONIC DRAWING LIBRARY

28 June 1994

The Middletown Site Airfield Electronic Drawing Library (EDL) will be maintained by the CAD/GIS Lead Analyst for the project. The contents will be organized into a set of sub-directories within the EDL, as follows:

- AutoCAD ADR Deliverable files
- ARC/CAD Site Base Map
- ARC/CAD Site Views
- ARC/CAD Working Map Files
- ARC/Info ACE Deliverable Files

ADR Deliverable AutoCAD Files

The aerial survey contractor, ADR, will deliver mylar drawings and corresponding AutoCAD files to ERM for each flight line and sheet that will be used to prepare the base map. These files will be installed on a hard disk for access over the ERM Novell network by the ERM GIS/CAD Group that will support the project activities. The mylars will be filed and maintained by the GIS/CAD Lead Analyst for the project.

The hard disk files will be backed-up weekly on a Bernoulli disk. The hard disk will also be backed-up semi-monthly on a CD. The original diskette files will be stored in a separate location to serve as a backup for the hard disk files.

Site Base Map

The source files obtained from ADR will be used to construct a base map for the complete Middletown Airfield Site consisting of planimetric features and topographic contours. The map files will be stored in layers containing each of the site features that have been specified. These files will be used to produce user-requested information products to support the project. When the base map files are modified they will be backed up weekly on the Bernoulli drive and semi-monthly on CD.

Site Views

A set of seven site views will be developed corresponding to the seven investigative areas defined in the Work Plan:

- Industrial Area - Building 142 Pipeline
- Industrial Area - Main Building Area
- Main Airport - Industrial Area Storm Sewers
- North Base Land Fill
- Meade Heights
- Susquehanna River
- HIA Production Well Field

Each of these views will be developed with the appropriate planimetric features to attain the appropriate level of detail to address the requirements of the investigative area. These views will be stored and backed up in the same manner as the base map. The views will serve as the background for portraying overlays of geological and chemical information collected during the project.

Working Map Files

Maps requested as information products will be produced in accordance with specifications defined by project team members. These products will be developed utilizing the previously developed base map and site views in conjunction with data extracted from the SIDMS database to meet project needs that are based on the nature of the data that results from field activities. These products will be termed Working Map Files, and will be stored in their own directory. They will be backed up in the same manner as the base map and view maps. Each Working Map file will be identified by a name that includes:

- Base map or View (Investigative Area)
- Coverage or Theme (Chemical or Geological Parameters)
- Version (1, 2, ...)
- Status (WORKING PRODUCT)

These naming conventions will facilitate access to the information for continuing use and to produce deliverable information products. All working map files will contain a status label, WORKING PRODUCT, as the default designation. This label will be included on all hard copy versions of the product that are used by project team members until actual deliverables are developed from them.

ACE Deliverables

The working product files will consist set of graphical representations of site conditions designed to provide the project team with an understanding of the nature and extent of contamination and risk conditions in conjunction with geology, topography, and planimetric features. It will be necessary to convey this understanding in the final report for the project. Using the working products, a selection will be made for inclusion as figures in the final report. The electronic files used to prepare these figures will be the electronic deliverables provided to ACE on completion of the project.

The same naming convention for View, Coverage, and Version will be used for the deliverable file names; however the Status will be designated as DRAFT DELIVERABLE for each selected information product. When a draft product has been approved for inclusion in the final report the status will be designated as a FINAL DELIVERABLE.

Electronic deliverables describing the results documented in the Middletown Airfield Site project final report will be provided to the USACE on completion of the project. The first of these will be an AutoCAD file (Product 1), and the remaining files will be in ARC/Info 6.1 format. The following electronic deliverable products will be submitted on completion of the project:

- Product 1 - Preliminary Base Map AutoCAD 12 file used in the Work Plan, obtained from R. E. Wright Associates
- Product 2 - Base Map for the complete MIddletown Airfield Site containing the planimetric features defined in the ADR specification
- Product 3 - Topography for the complete Middletown Airfield Site
- Products 4 to 8 - Five views consisting of planimetrics and topography to serve as localized base maps for the seven Investigative Areas

- Products 9 to 35 - Information products included as hard copy in the final report consisting of the base map or view features, topography, and the associated database coverage/theme information for each view. It is expected that six information products will be developed to describe key findings relating to the base map and an average of three products for each of the seven Investigative Areas, for a total of 27 information products. The figures will include the following types of information:
  - Soil/sediment sampling locations
  - Ground water sampling locations
  - Ground water elevation posted values/contours
  - Chemical concentration posted values/contours
  - Geologic parameter locations, values/contours
  - Cross sections
- The following SIDMS data tables will be provided in FoxPro for Windows format compatible with dBase IV. They will contain the source data from which the information products were developed:
  1. Area
  2. Borehole Completion
  3. Borehole Interval
  4. Borehole Parameter
  6. Borehole Geophysics
  7. Borehole Geophysics Data
  8. Calculated Hydrologic
  9. Chemical Results
  10. Compound
  11. Ground Water
  12. Location
  13. Project
  14. QC Results
  15. Sample

16. Screening Level
17. Well Construction

The electronic deliverables will be prepared after the draft report has been submitted and accepted by the USACE. The electronic files will be submitted to the USACE on 3.5 inch diskettes within two weeks after submittal of the approved final report for the project. A letter of transmittal will accompany the submittal and will include

- file names
- relationship of each file to the related figure in the final report
- descriptions of each file.

Appendix D
Field Data Collection Form for Drilling Logs

APPENDIX D FIELD DATA COLLECTION FORM FOR DRILLING LOGS

28 June 1994

ERM field teams will collect data describing stratigraphy and other geologic parameters associated with each borehole and well that is drilled during the course of the Middletown Airfield Site project. Field notebooks used to collect the data represent the defensible source data for the database. A standard data collection form will be used to code the data so that it can be entered into the appropriate SIDMS data tables. Attachment D-1 contains the data collection forms that will be used for this purpose.

Data management personnel will key-enter data from these forms into the database tables using the SIDMS data entry screens.

ATTACHMENT D-1

BORING COMPLETION AND WELL CONSTRUCTION

PROJECT [redacted] I D D L E T O W N [redacted]

	AREA ID	LOCATION	BORING TYPE	BEGIN DATE	END DATE	DEVELOPMENT DATE
1						
2						
3						
4						
5						
6						
7						

	LOGGER	TOTAL DEPTH	DEPTH TO BEDROCK	DEPTH TO SATURATION	GZC*	STICKUP
1						
2						
3						
4						
5						
6						
7						

	UNITS	DRILLING CODE	RIG TYPE	FLUID	DRILLING COMPANY
1					
2					
3					
4					
5					
6					
7					

	DRILLER	ABANDONMENT METHOD	BOREHOLE DIAMETER	*REMARKS*
1				Place on back of sheet - please number.
2				
3				
4				
5				
6				
7				

* GZC = Geologic Zone of Completion

AR303435

ATTACHMENT D-1

BORING INTERVAL TABLE

PROJECT: M I D D L E T O W N

	LOCATION ID	INTERVAL GROUP	INTERVAL ID	INTERVAL TOP	INTERVAL BOTTOM
1					
2					
3					

REMARKS

Description for this interval
Description for this interval
Description for this interval
and associated parameters.
Please use back of form.

	PARAMETER	OBSERVATION	UNITS
1	LITHOLOGY		
2	STRATIGRAPHY		
3			
4			
5			
6			
7			
1	LITHOLOGY		
2	STRATIGRAPHY		
3			
4			
5			
6			
7			
1	LITHOLOGY		
2	STRATIGRAPHY		
3			
4			
5			
6			
7			

ATTACHMENT D-1

WELL CONSTRUCTION DATA

PROJECT: M I D D L E T O W N

	LOCATION	INTERVAL TOP (FEET)	INTERVAL BOTTOM (FEET)
1			
2			
3			
4			
5			
6			
7			
8			

	PARAMETER/ WELL COMPONENT	MATERIAL
1		
2		
3		
4		
5		
6		
7		
8		

	INNER DIAMETER	OUTER DIAMETER	VALUE	UNITS
1				
2				
3				
4				
5				
6				
7				
8				

MESSAGE

Where a parameter requires a value instead of inner or outer parmeter, put this value in the spaces to the right. Please include units where applicable.

DESCRIPTION

Place on back of sheet - please number.

AR303437

Appendix E
Information Product Request Form

APPENDIX E INFORMATION PRODUCT REQUEST FORM

28 June 1994

Information products consisting of tables, graphs, and maps will be produced from the SIDMS database and the AutoCAD map files for the Middletown Airfield Site. Information Products will be developed using the ERM CAD Work Request Form, which is included as Attachment E-1. The two essential information categories on the form will be filled out as follows:

- Brief Description of this Job - The type of product that is requested will relate to the Electronic Library definitions and the database tables described in Appendix C; i. e., the Base Map or View as well as the associated data tables and Status will be defined in the request. If a prior version of the product has been developed its file name will be identified in the request specification.
- File Information - The name of the file to be produced as a Working Product or Deliverable, and the names of files used in preparing the product will be identified.
- Drawing Types - The alphabetic set of drawing type codes defined in the Work Request will be used to define the product.

The GIS/CAD Lead Analyst for the Middletown Airfield Site will maintain the file of CAD Work Requests throughout the project. The Data Management Task Manager will maintain a summary of information product requests in a spreadsheet format to provide the Project Manager with an overview of GIS/CAD activities associated with working products and deliverables.

C.A.D. WORK REQUEST

Work Order Number

Client

Your Name

Extension

Todays Date

Preferred Date Due

Actual Date Due

A Brief Description of This Job:

FILE INFORMATION (FOR DRAFTING USE ONLY)

Drawing Information, Tracking Information

AR303440

Directory | Drawing Name

Work Order Number	Phase	Group	Type	Size	Number

Groups:

Health & Safety	HS
Concept Engineering	CE
Engineering D&C	DC
Geoenvironmental Science	GS
Hydrogeology	HY
Environmental Systems	ES
Management Consulting	MC
Government Business	GB
EnviroClean	EC
Annapolis	AN
Pittsburgh	PB
Princeton	PR
Richmond	RD
McLean	MC

Drawing Types:

Base Map	A
Regional Map	B
Site Location Map	C
Topographic Map	D
Cross Section	E
Charts & Graphs	F
Well Logs	G
Well Diagrams	H
Details	I
Profiles	J
P&ID's	K
Cut & Fills	L
Process Flow	M
Fence Diagrams	N
Miscellaneous	X
3D Drawings	Z

Sizes:

8 ½ x 11	1
11 x 17	2
24 x 36	3
Larger than 24 x 36	4

FINAL WORK PLAN

Middletown Airfield Site
Middletown, Pennsylvania

Site Safety and Health Plan

1 July 1994

Appendix C
Site Safety and Health Plan

Final
Site Safety and Health Plan
Supplemental Studies
Middletown Airfield Site
Middletown, PA

Prepared for
U.S. Army Corps of Engineers
215 N. 17th Street
Omaha, Nebraska 68102-4978

Prepared by
ERM Program Management Company
855 Springdale Drive
Exton, PA 19341

1 JULY 1994

Joseph B. Baker

Joseph Baker, CIH, CSP
ERM Project Safety Supervisor

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDICES

1.0 PURPOSE AND REFERENCES

The purpose of this Site Safety and Health Plan (SSHP) is to assign responsibilities, to establish personnel protection standards, mandatory safety practices and procedures, and to provide for contingencies that may arise while the field operations are conducted as part of the investigation of the impact of contaminated soils on the ground water at the Middletown Airfield Site (MAS). The procedures outlined in this plan are in conformance with the Environmental Resources Management, Inc. (ERM) Corporate Health and Safety Program and have been developed to comply with applicable local, State, Federal, and U.S. Army Corps of Engineers (USACE) safety requirements.

The procedures set forth in this plan are designed to reduce the risk of exposure to chemical substances by ERM employees conducting field investigation work. The procedures set forth herein are developed in accordance with the provisions of 29 CFR 1910.120 (Hazardous Waste Operations and Emergency Response) and in accordance with corporate experience in similar field operations. The procedures in this plan have been developed for use during those activities involving ERM personnel. ERM shall be responsible solely for compliance with the provisions of the SSHP by ERM employees, subcontractors of ERM (on-site activities only) where applicable, and designated personnel other than ERM employees and subcontractors. Any other personnel are required to prepare and are responsible for administration of their own health and safety program. If these personnel are present on sites where field operations are being conducted, ERM will inform them that it is the responsibility of their employer to provide them with health and safety information (including training, medical monitoring, equipment, etc.) in compliance with relevant regulations. If any personnel other than those explicitly authorized by contract or subcontract agreement or specifically mentioned in this plan should use this plan without the expressed authority of ERM, they do so at their sole risk.

The recommended health and safety guidelines set forth within this document may be modified as further information is made available during sample analysis and/or on-site characterization. Site-specific information is presented in Sections 2 through 14 of this plan, with general health and safety information presented in Appendices A through H.

Specific goals of this plan include:

1. Detail the safety, accident, and fire protection standards and procedures to be used during the course of the project;
2. Outline standard operating procedures to ensure the safety of all ERM, MAS, and subcontractor personnel performing activities associated with the MAS investigations;
3. Outline the emergency and contingency plans for protection of ERM and subcontractor personnel and for any contingencies which might also affect MAS personnel; and
4. Designate the responsibilities and authorities for implementing this plan, as well as reporting procedures.

The evaluation of hazards, the levels of protection, and the procedures presented in this plan are based on the best and most current available information regarding the conditions at MAS. The specifications described herein represent the minimum health and safety requirements to be observed by all site personnel. Unforeseen conditions or personnel preferences may require the use of higher levels of protection. Because site conditions may change, it is required that selected personal protective measures be continually assessed by the designated Site Safety Officer and approved by the Project Safety Supervisor prior to and during the field investigations. All project personnel must read this document carefully and complete a sign-off sheet prior to initiation of field work.

Each field team will have a copy of the plan in their vehicle for easy reference. Safety briefings will be conducted on site whenever new field teams and/or visitors arrive on site. At this time, any modifications to the plan as necessitated by changing field conditions will be explained and documented by an addendum to the plan. The plan will also be made available for review by MAS representatives and U.S. Army Corps of Engineers (USACE) representatives, as necessary.

This SSHP and all field activities at MAS will be in compliance with the most current versions of the following reference documents:

- Federal Acquisition Regulation, F.A.R. Clause 52.236.13: Accident Prevention;
- U.S. Army Corps of Engineers (USACE), Safety and Health Requirements Manual, EM 385-1-1 (latest revision);
- Occupational Safety and Health Administration (OSHA) Construction Industry Standards, 29 CFR 1926; and General Industry Standards, 29

CFR 1910; especially 29 CFR 1910/120 - "Hazardous Waste Site Operations and Emergency Responses".

- NIOSH/OSHA/USGS/EPA Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, October 1985; and
- Other applicable federal, state, and local safety and health requirements.

2.0 SITE INFORMATION

The Middletown Airfield Site comprises approximately 1,540 acres of what was the site of the former Olmsted Air Force Base. The site is located approximately 8 miles southeast of Harrisburg, Pennsylvania along Pennsylvania Route 230 between the towns of Highspire and Middletown in Dauphin County. The Susquehanna River forms the southern boundary of the site.

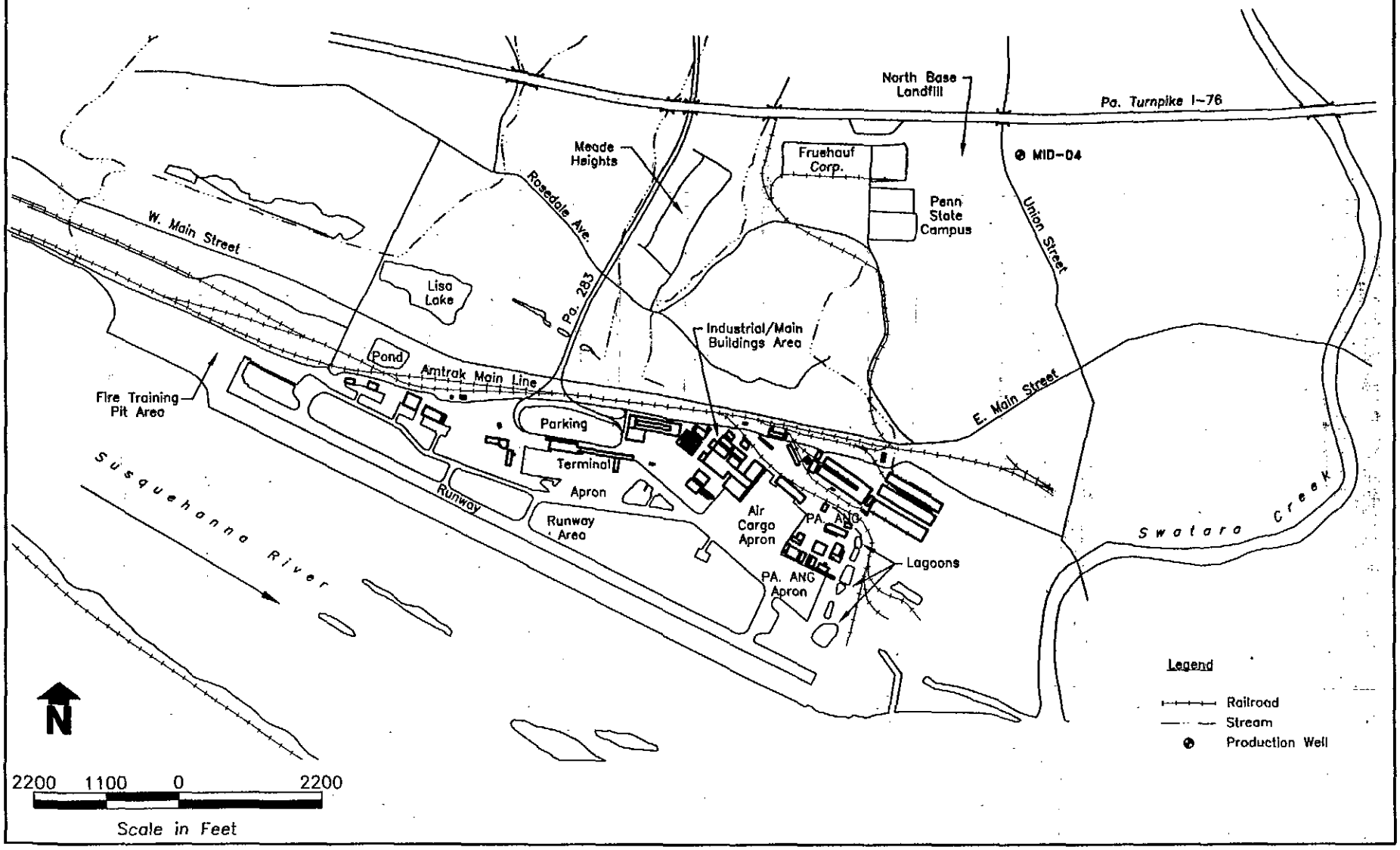
The property occupied by the Middletown Airfield Site was initially established by the Army as a basic training camp in 1898. In 1917, the Army Signal Corps established a storage depot known as the Aviation General Depot consisting of warehouses, open sheds, and garages. This depot was renamed in 1921 as the Middletown Air Intermediate Depot. Flying activities at the base began in 1918 and the airfield was named the Olmsted Field in 1923. Through World War II various Air Corps material was stored at the site. Activities at the base consisted of complete overhauling of aircraft including stripping, repainting, engine overhaul, reassembly, and equipment replacement as well as general base support maintenance and operation. In 1947, Olmsted Field was renamed Olmsted Air Force Base to coincide with the designation of the Air Force as a separate Department of Defense establishment. In 1956, a major expansion of existing runways to handle jet aircraft was undertaken. In the early 1960s, Air Force operations began to decrease and all operations were ceased by 1966.

The Air Force airfield and many of the Air Force buildings are now owned by the Pennsylvania Department of Transportation (PADOT) and operated as the Harrisburg International Airport (HIA) by PADOT's Bureau of Aviation. HIA property is leased to a variety of tenants including small private manufacturing companies, aircraft repair services, car rental companies, and the Pennsylvania Air National Guard, among others. The property north of Pennsylvania Route 230 is owned by Fruehauf Company, the Odd Fellows Organization, and a branch campus of the Pennsylvania State University.

The Supplemental Studies (SS) at MAS will involve collection of environmental samples to determine whether substances are present and whether they are being released into the environment. The sites being investigated include the Runway Area, Industrial Main Building Area, North Base Landfill, Meade Heights Area and the Susquehanna River

(Figure 2-1). The approximate duration of site activities is expected to last approximately 11 months.

Figure 2-1
Areas of Investigation
Middletown Airfield Site
Middletown, Pennsylvania



THE ERM GROUP

PM005.02.01/02.22.94-DST/02.24.94-DST/A101-4

AR303452

3.0 PROPOSED ON-SITE INVESTIGATIONS

The scope of work involves a pipeline integrity survey, soil, vapor, water and sediment sampling as well as well installation and monitoring. A detailed description of all field investigation activities are listed in Table 3-1.

Table 3-1 *Summary of Field Investigations and Potential Contamination*
Middletown Airfield Site

Site	Activity	Potential Contamination
Industrial Area-Building 142 Pipeline	• Pipeline integrity survey from Building 142 to Lagoons	• Various solvents that may be used in Building 142 operations
	• Conduct direct push vapor sampling from 6-8 feet below grade at 60 locations along Building 142 pipeline and 40 locations around Waste Sump House	• PCE, TCE, chlorobenzene, 1,2 DCE, BTEX, 1,2-1,3-1,4-dichlorobenzene, vinyl chloride
	• Collect 2 direct push soil samples from 20 borings along Building 142 pipeline and Waste Sump House and 5 borings around Lagoons	• PCE, TCE, chlorobenzene, 1,2 DCE, BTEX, 1,2-1,3-1,4-dichlorobenzene, vinyl chloride
	• Collect 5 samples from each of 12 HSA soil borings, 10 borings along pipeline routes and 2 borings at Lagoon	• PCE, TCE, chlorobenzene, 1,2 DCE, BTEX, 1,2-1,3-1,4-dichlorobenzene, vinyl chloride
	• Collect 2 samples per boring for geotechnical analysis	• PCE, TCE, chlorobenzene, 1,2 DCE, BTEX, 1,2-1,3-1,4-dichlorobenzene, vinyl chloride
	• Based on CG screening, select 3 samples from each of 12 borings for analysis	• PCE, TCE, chlorobenzene, 1,2 DCE, BTEX, 1,2-1,3-1,4-dichlorobenzene, vinyl chloride

Site	Activity	Potential Contamination
	• Collect a surface scrape sample (0-2') from 2 boring locations along pipeline and 2 boring locations at Lagoons	• PCE, TCE, chlorobenzene, dichlorobenzene, chromium, lead, barium, arsenic, cadmium, nickel, pesticides, PCBs
	• Install and sample 2 shallow and 2 intermediate depth monitoring wells along Building 142 pipeline; sample shallow wells for VOCs with 14 day turnaround to locate intermediate wells	• PCE, TCE, chlorobenzene, 1,2 DCE, BTEX, 1,2-1,3-1,4 dichlorobenzene, chromium, lead, barium, arsenic, cadmium, nickel, pesticides
	• Install and sample 1 shallow and 1 intermediate depth monitoring well at Lagoons	• PCE, TCE, chlorobenzene, dichlorobenzene, chromium, lead, barium, arsenic, cadmium, nickel, pesticides, PCBs
	• Collect 5 samples from each of 3 shallow monitoring well borings	• PCE, TCE, chlorobenzene, 1,2-DCE, BTEX, 1,2-1,3-1,4-dichlorobenzene, vinyl chloride
	• Based on GC screening, select 3 samples from each shallow well boring plus 1 surface sample (0-2') from shallow well locations at Lagoons	• PCE, TCE, chlorobenzene, dichlorobenzene, chromium, lead, barium, arsenic, cadmium, nickel, pesticides, PCBs

Table 3-1 ***Summary of Field Investigations and Potential Contamination***
Middletown Airfield Site

Site	Activity	Potential Contamination
	• Collect 2 samples from each of 3 shallow well boring for geotechnical analysis	• PCE, TCE, chlorobenzene, dichlorobenzene, chromium, lead, barium, arsenic, cadmium, nickel, pesticides, PCBs
Industrial Area - Main Buildings Area	• Collect 5 samples from each of 30 HSA borings	• PCE, TCE, chlorobenzene, 1,2-DCE, BTEX, 1,2-1,3-1,4-dichlorobenzene, vinyl chloride
	• Based on GC screening, select 3 soil samples from each boring plus 10 surface samples (0-2") for analysis	• PCE, TCE, chlorobenzene, 1,2-DCE, BTEX, 1,2-1,3-1,4-dichlorobenzene, vinyl chloride, chromium, lead, barium, arsenic, cadmium, nickel, pesticides, PCBs
	• Select 10% of soil samples for geotechnical analysis	• PCE, TCE, chlorobenzene, 1,2-DCE, BTEX, 1,2-1,3-1,4-dichlorobenzene, vinyl chloride, chromium, lead, barium, arsenic, cadmium, nickel, pesticides, PCBs

Site	Activity	Potential Contamination
	• Install and sample 3 shallow, 3 intermediate depth, and 1 deep monitoring well; sample shallow wells for VOCs with 14 day turnaround to locate intermediate and deep wells	• PCE, TCE, chlorobenzene, dichlorobenzene, chromium, lead, barium, arsenic, cadmium, nickel, pesticides, PCBs
	• Collect 5 samples from each of 3 shallow well borings	• PCE, TCE, chlorobenzene, 1,2 DCE, BTEX, 1,2-1,3-1,4-dichlorobenzene, vinyl chloride
	• Based on GC screening, select three soil samples from each shallow well boring plus 1 surface sample (0-2') for analysis	• PCE, TCE, chlorobenzene, 1,2-DCE, BTEX, 1,2-1,3-1,4-dichlorobenzene, chromium, lead, barium, arsenic, cadmium, nickel, pesticides, PCBs
	• Collect 2 samples from each of 3 shallow well borings for geotechnical analysis	• PCE, TCE, chlorobenzene, 1,2-DCE, BTEX, 1,2-1,3-1,4-dichlorobenzene, chromium, lead, barium, arsenic, cadmium, nickel, pesticides, PCBs
North Base Landfill	• Collect up to 75 direct push ground water samples at an average depth of 20 feet	• PCE, TCE, chlorobenzene, 1,2-DCE, BTEX, 1,2-1,3-1,4-dichlorobenzene, chromium, lead, barium, arsenic, cadmium, nickel, pesticides, PCBs

Table 3-1 *Summary of Field Investigations and Potential Contamination*
Middletown Airfield Site

Site	Activity	Potential Contamination
	• Install and sample 2 shallow and two intermediate depth sentinel wells	• PCE, TCE, chlorobenzene, 1,2-DCE, BTEX, 1,2-1,3-1,4-dichlorobenzene, chromium, lead, barium, arsenic, cadmium, nickel, pesticides, PCBs
	• Install 2 shallow, 2 intermediate, and 2 deep piezometers	• PCE, TCE, chlorobenzene, 1,2-DCE, BTEX, 1,2-1,3-1,4-dichlorobenzene, chromium, lead, barium, arsenic, cadmium, nickel, pesticides, PCBs
	• Install and sample 2 shallow and 7 intermediate depth monitoring wells	• PCE, TCE, chlorobenzene, 1,2-DCE, BTEX, 1,2-1,3-1,4-dichlorobenzene, chromium, lead, barium, arsenic, cadmium, nickel, pesticides
	• Collect 2 samples from each of 2 shallow well borings for geotechnical analysis	• PCE, TCE, chlorobenzene, 1,2-DCE, BTEX, 1,2-1,3-1,4-dichlorobenzene, chromium, lead, barium, arsenic, cadmium, nickel, pesticides
Main Airport/Industrial Area Storm Sewers	• Collect 30 sediment samples from storm drains	• PCE, TCE, chlorobenzene, 1,2-DCE, BTEX, 1,2-1,3-1,4-dichlorobenzene, chromium, lead, barium, arsenic, cadmium, nickel, pesticides, PCBs

Site	Activity	Potential Contamination
Meade Heights	• Collect surface water and sediment samples from 4 locations	• PCE, TCE, chlorobenzene, 1,2-DCE, BTEX, 1,2-1,3-1,4-dichlorobenzene, chromium, lead, barium, arsenic, cadmium, nickel, pesticides, PCBs
	• Perform aquatic survey of macroinvertebrates, aquatic insects, and fish at 4 points	• PCE, TCE, chlorobenzene, 1,2-DCE, BTEX, 1,2-1,3-1,4-dichlorobenzene, chromium, lead, barium, arsenic, cadmium, nickel, pesticides, PCBs
Susquehanna River	• Collect surface water and sediment samples from 4 locations	• PCE, TCE, chlorobenzene, 1,2-DCE, BTEX, 1,2-1,3-1,4-dichlorobenzene, chromium, lead, barium, arsenic, cadmium, nickel, pesticides, PCBs
	• Collect sediment sample from 4 locations in river, coincident with surface water sampling	• PCE, TCE, chlorobenzene, dichlorobenzene, chromium, lead barium, arsenic, cadmium, nickel, pesticides, PCBs
HIA Production Wells	• Conduct borehole camera survey of 3 HIA wells	• PCE, TCE, chlorobenzene, dichlorobenzene, chromium, lead barium, arsenic, cadmium, nickel, pesticides, PCBs

Table 3-1 *Summary of Field Investigations and Potential Contamination*
Middletown Airfield Site

Site	Activity	Potential Contamination
	• Conduct borehole geophysical logging at each of 3 HIA wells under static conditions. Based on logs, collect depth-specific samples from 5 intervals in each well	• PCE, TCE, chlorobenzene, dichlorobenzene, chromium, lead barium, arsenic, cadmium, nickel, pesticides
	• Install test pump and begin pumping well. While pump is running, conduct borehole logging. Based on logs, collect depth-specific samples from 5 intervals in each well under flowing conditions	• PCE, TCE, chlorobenzene, dichlorobenzene, chromium, lead barium, arsenic, cadmium, nickel, pesticides
Runway Area	• Install and sample 3 shallow and 2 intermediate depth monitoring wells	• PCE, TCE, chlorobenzene, dichlorobenzene, chromium, lead barium, arsenic, cadmium, nickel, pesticides
	• Collect 2 samples from each of 3 shallow well borings for geotechnical analysis	• PCE, TCE, chlorobenzene, dichlorobenzene, chromium, lead barium, arsenic, cadmium, nickel, pesticides

Site	Activity	Potential Contamination
Industrial Area Capture Zone Tests	• Install and sample 6 shallow, 6 intermediate depth, and 6 deep monitoring wells	• PCE, TCE, chlorobenzene, 1,2-DCE, BTEX, 1,2-1,3-1,4-dichlorobenzene, vinyl chloride, chromium, lead, barium, arsenic, cadmium, nickel, pesticides
Deep Ground Water Flow Determination	• Install and sample 3 deep (800') monitoring wells	• PCE, TCE, chlorobenzene, 1,2-DCE, BTEX, 1,2-1,3-1,4-dichlorobenzene, vinyl chloride, chromium, lead, barium, arsenic, cadmium, nickel
Background Soils	• Collect surface samples (0-2") and 3 subsurface samples from each of 5 borings in background locations (discrete samples for VOCs analysis and composite samples for other parameters)	• PCE, TCE, chlorobenzene, 1,2-DCE, BTEX, 1,2-1,3-1,4-dichlorobenzene, vinyl chloride, chromium, lead, barium, arsenic, cadmium, nickel, pesticides
Existing Monitoring Wells	• Sample 48 existing monitoring wells	• PCE, TCE, chlorobenzene, 1,2-DCE, BTEX, 1,2-1,3-1,4-dichlorobenzene, vinyl chloride, chromium, lead, barium, arsenic, cadmium, nickel, pesticides, PCBs

Table 3-1 *Summary of Field Investigations and Potential Contamination*
Middletown Airfield Site

Site	Activity	Potential Contamination
Production Wells	• Sample MID-04 and 13 HIA production wells	• PCE, TCE, chlorobenzene, 1,2-DCE, BTEX, 1,2-1,3-1,4-dichlorobenzene, vinyl chloride, chromium, lead, barium, arsenic, cadmium, nickel
Residential Wells	• Sample up to 8 residential wells, including Odd Fellow Home well	• PCE, TCE, chlorobenzene, 1,2-DCE, BTEX, 1,2-1,3-1,4-dichlorobenzene, vinyl chloride, chromium, lead, barium, arsenic, cadmium, nickel, pesticides
SVE Pilot Testing	• Install 1 4"SVE vacuum well and 3 SVE monitoring piezometers and perform OVA headspace screening on soil samples collected from ground surface to water table or bedrock	• To be determined
	• Based on OVA screening, select 3 samples from each boring for analysis	• To be determined
	• Collect vapor samples on a regular basis during 3-4 day pilot test	• To be determined

Site	Activity	Potential Contamination
Quarterly Monitoring Program	• Conduct quarterly sampling of the Susquehanna River and the Sentinel wells at the North Base Landfill, as described below, through the third calendar quarter of 1995 (7 quarters following initial sampling)	
Susquehanna River	• Collect surface water samples from 4 locations	• PCE, TCE, chlorobenzene, 1,2-DCE, BTEX, 1,2-1,3-1,4-dichlorobenzene, chromium, lead, barium, arsenic, cadmium, nickel
	• Collect sediment samples from 4 locations, coincident with surface water sampling	• PCE, TCE, chlorobenzene, 1,2-DCE, BTEX, 1,2-1,3-1,4-dichlorobenzene, vinyl chloride, chromium, lead, barium, arsenic, cadmium, nickel
North Base Landfill - Sentinel Wells	• Sample 2 shallow and 2 intermediate Sentinel wells	• PCE, TCE, chlorobenzene, 1,2-DCE, BTEX, 1,2-1,3-1,4-dichlorobenzene, chromium, lead, barium, arsenic, cadmium, nickel, pesticides

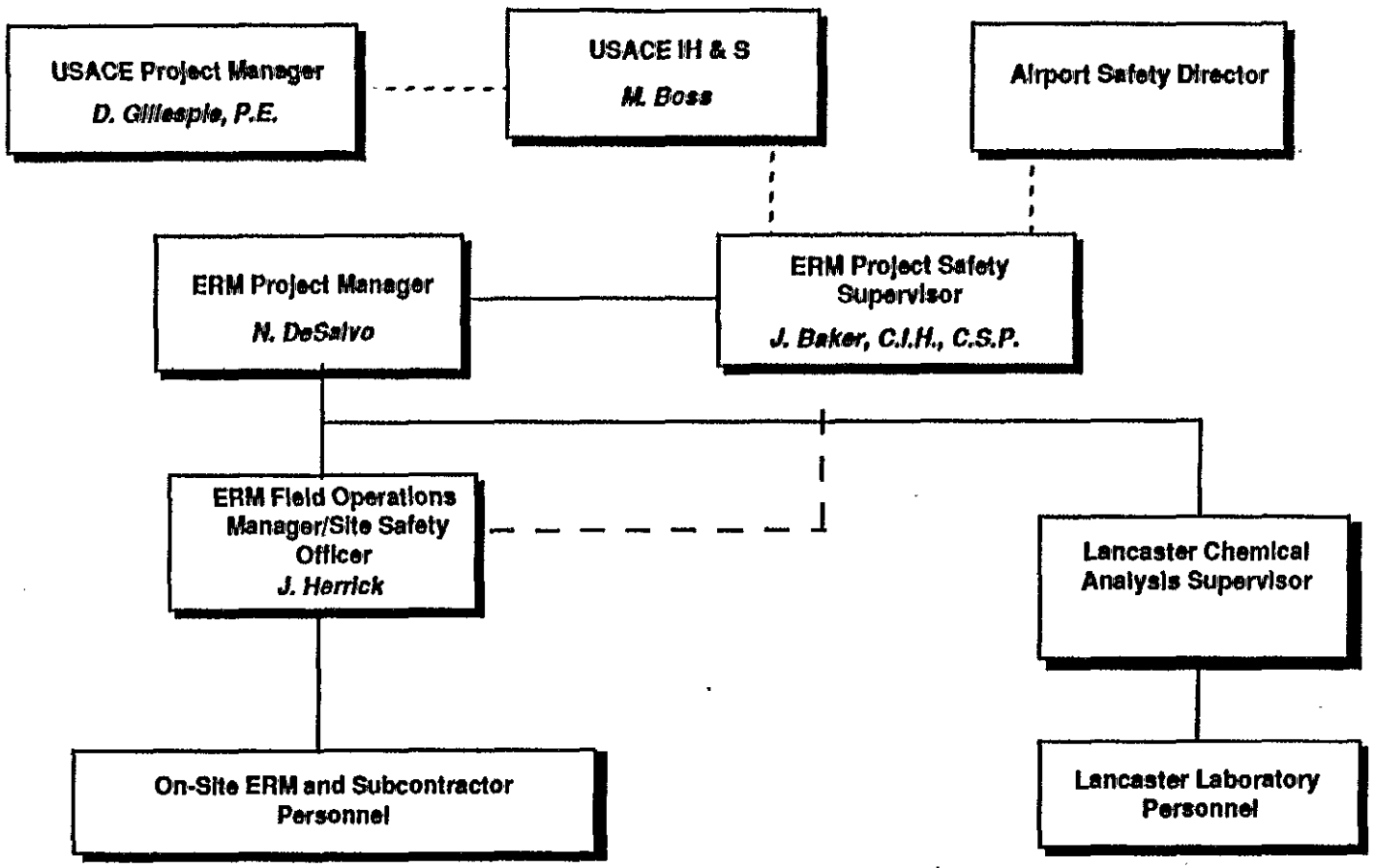
4.0 SAFETY ORGANIZATION, ADMINISTRATION, AND RESPONSIBILITIES

Figure 4-1 presents the project safety organization and lines of authority and communication associated with the investigation effort at MAS. The following sections present details regarding the individual responsibilities of each of the designated members of the ERM project safety organization. The Project Safety Supervisor is authorized by the Project Manager to require compliance with safety operating procedures, required personnel protection levels, and sample/reagent transport, and has full authority to halt any procedures and/or activities being conducted in an unsafe manner. Safe performance of the MAS investigation is the responsibility of all involved personnel. A key element of the plan is the continuous reliance upon the "buddy system" for all site activities. This system requires that all on-site activities be conducted using a minimum of 2-person teams. However, in the case of the storm sewer sediment sampling, 3-person teams will be used because of confined space sediment sampling activities.

ERM Project Manager

Mr. Nicholas DeSalvo is the Project Manager (PM) for all aspects of the investigation. The PM has direct line responsibility for the completion of the technical aspects of the task order, as well as control over the financial, and schedule components. Overall responsibility for the safe conduct of the on-site activities rests with the PM. His responsibilities include:

1. Reporting to MAS personnel regarding technical project issues.
2. Reporting to USACE personnel regarding technical and administrative project issues.
3. Coordinating preparation of an effective, approved SSHP for the project;
4. In conjunction with the Project Safety Supervisor, characterizing the specific chemical and physical hazards which potentially may be encountered during conduct of the MAS SS;
5. Assuring that adequate and appropriate safety training and equipment are available for project personnel;
6. Arranging for medical examinations for specified project personnel, if necessary; and
7. Designating a Project Safety Supervisor.



Source: ERM, 1993

Figure 4-1
SAFETY ORGANIZATION
MIDDLETOWN AIRFIELD SITE

Prepared for:
U.S. Army Corps of Engineers

Omaha, Nebraska

ERM Project Safety Supervisor

Mr. Joseph Baker, CIH, has corporate-level responsibility for the implementation and maintenance of the ERM Corporate Health and Safety Program. For the MAS SS , Mr. Baker has been designated by the PM to ensure that the required air monitoring will be accomplished. He has primary responsibility for:

1. Briefing all field personnel of the project safety requirements and protocols;
2. Training the Field Operations Manager in conducting on-site safety supervision and coordination with MAS personnel;
3. Defining and monitoring required reagent and sample handling and shipping requirements.

Project-specific responsibilities of the Project Safety Supervisor include:

1. Approving all safety procedures and operations on site;
2. Updating equipment or procedures based upon new information gathered during the site inspection;
3. Upgrading or downgrading the levels of personnel protection based upon Field Operations Manager/Site Safety Officer site observations. Downgrading requires the approval of the PM and notification of USACE-IH and S;
4. Determining and posting locations and routes to medical facilities, including poison control centers, and arranging emergency transportation to medical facilities (as required);
5. Notifying (as required) MAS emergency responders (i.e., police and fire department) of the nature of the team's operations, and making emergency telephone numbers available to all team members;
6. Assuring that:
   a. At least one member of the field team is available to stay behind and notify the appropriate emergency personnel if the Project Safety Supervisor or Field Operations Manager must enter an area of maximum hazard, or
   b. The area is not entered until the Project Safety Supervisor or Field Operations Manager has notified local Emergency Services (fire department);
7. Observing work party members for symptoms of exposure or stress; and

8. Arranging for the availability of on-site emergency medical care and first aid, as necessary.

Because the chemical health hazard potential for activities at MAS is low, the project specific responsibilities of the Project Safety Supervisor will generally be delegated to the Field Operations Manager after proper instruction by the Project Safety Supervisor. The Project Safety Supervisor (or his designate) has the ultimate responsibility to stop any operation that threatens the health or safety of the team, surrounding populace, property, or may cause significant adverse impact to the environment.

ERM Field Operations Manager/Site Safety Officer

Mr. Jeffrey Herrick is the Field Operations Manager for this task order and will be responsible for the in-field conduct of the drilling and sampling efforts. As described above, he will be the designated Site Safety Officer, reporting through the Project Safety Supervisor. Mr. Herrick will have completed the OSHA 8-hour Supervisor/Managers course and ERM's Confined Space Entry Training and will have received training in CPR and First Aid. In addition to the delegated responsibilities from the Project Safety Supervisor described above, the Site Safety Officer, has the following responsibilities:

1. Assuring and enforcing compliance with the project safety plan,
2. Coordinating site activities such that they may be performed in an efficient and safe manner consistent with the project safety plan,
3. Informing project staff as to their potential exposure to any dangerous levels of hazardous materials,
4. Enforcing the "buddy system" on site, and
5. Assuring the ready access and availability of all safety equipment.

The Site Safety Officer (ERM Field Operations Manager) will coordinate project safety procedures with the USACE Industrial Hygienist and Safety Officer (USACE-IH and S). These contacts are as follows:

USACE Project Manager, Mr. Dan Gillespie, (402) 221-7168

USACE Industrial Hygienist/
Safety Officer , Ms. Martha Boss, (402) 221-7693

All project personnel performing work on site have a shared responsibility to conduct the project in a safe manner. These specific responsibilities include:

1. Complying with all aspects of the project safety plan, including strict adherence to the "buddy system;"
2. Obeying the orders of the Field Operations Manager/Site Safety Officer; and
3. Notifying the Field Operations Manager/Site Safety Officer of hazardous or potentially hazardous incidents or working situations.

ERM Site Geologist

The Site Geologist and is charged with the conduct of the field and related activities specific to this task order. The field activities, which include completion of soil borings, installation of monitor wells, and environmental sampling, represent the work elements within which potential health risk exposures exist. In the event that the Field Operations Manager is not present at the site during field operations, he may delegate portions of his project-specific safety responsibility to the Site Geologist provided the Site Geologist has completed appropriate supervision training.

5.0 SITE ACCESS AND SITE CONTROL

5.1 SITE ACCESS

Each area of investigation will be divided into work zones as a means to control site access while field investigations are on-going and to facilitate decontamination efforts. Work zones generally will include the following:

- Support Zone: clean area, storage for excess non-contaminated equipment;
- Contaminant Reduction ("decon") Zone (CRZ): area in which site-specific decontamination processes will take place; location of the decontamination equipment and used personal protective equipment (PPE);
- Exclusion Zone: potentially contaminated area.

These zones will be established by the Site Safety Officer and will be maintained throughout the field effort at each specific work site. Access to the site will occur through the appropriate access points.

Access to the work site during the investigation and well sampling activities will be limited to authorized personnel only. Site access will be provided to authorized personnel who have received the proper OSHA health and safety training and medical surveillance, and in the case of the storm sewer sediment sampling 8-hour confined space training, have reviewed the investigation SSHP, and have been briefed by the ERM Field Operation Manager/Site Safety Officer.

Access into the established exclusion zone or work area will be limited to those authorized personnel wearing appropriate PPE. The exclusion zones will be cordoned off with colored flagging or other appropriate means, designating the exclusion zone boundary. The zones will be monitored by the Site Safety Officer or his designee to ensure unauthorized personnel do not enter.

5.2 *SITE CONTROL*

MAS is secured by HIA personnel 24 hours a day.

Certain procedures will be followed to ensure suitable site control and limitation of access so that those persons who may be unaware of site conditions are not exposed to inherent hazards. Plywood sheeting or other protective measures will be placed over boreholes when left unattended during non-working hours. Any field equipment which may cause potential injury when left unattended will be removed from the site or otherwise rendered non-dangerous. The Field Operations Manager will be responsible to see that the specific work areas are secure during non-working hours. Airport security personnel will be contacted prior to leaving excavations or equipment overnight.

6.0 PERSONNEL TRAINING

General site workers (such as equipment operators, general laborers and supervisory personnel) engaged in hazardous substance removal or other activities which expose or potentially expose workers to hazardous substances and health hazards shall receive a minimum of 40 hours of instruction off the site, and a minimum of three days actual field experience under the direct supervision of a trained, experienced supervisor. Exceptions to this requirement, e.g., decreasing the number of training hours to 24, are found in Appendix A of this SSHP. Exceptions from training are subject to review by the Project Safety Supervisor and the Site Safety Officer. Normal work procedures of the field team are not expected to preclude the necessary 40 hours of off-site instruction.

This SSHP will be distributed to all subcontractors prior to the start of field activities. A pre-operation meeting will be held to discuss the contents of the Plan. Specialty training will be provided based on task and responsibility. All training of personnel will be conducted under direct supervision of the Site Safety Officer.

ERM contractors and subcontractors will document their compliance to the training and medical requirements by completing the form shown in Figure 6-1. This form will remain onsite for the duration of the project for review by the appropriate regulatory agencies.

A more detailed discussion of training requirements is included in Appendix A.

FIGURE 6-1 *CONTRACTOR OCCUPATIONAL SAFETY AND HEALTH CERTIFICATION*

PROJECT: Middletown Airfield Site (MAS)

CONTRACTOR: _____

1. Contractor certifies that the following personnel to be employed during the MAS Supplemental Studies (SS) have met the following requirements of the OSHA Hazardous Waste Operations Standard (29 CFR 1910.120) and other applicable OSHA standards, as required by ERM.

Subcontractor Personnel	Training	Respirator Certification	Medical Exam
example: John Smith	3/6/90 ERM	3/6/93 ERM (small MSA)	2/27/90 Paoli

2. Subcontractor certifies that it has received a copy of the Health and Safety Plan and will ensure that its employees are informed and will comply with its requirements.

3. Subcontractor further certifies that it has read and understands and will comply with all provisions of its contractual agreement.

Authorized Signature: _____

Title: _____

Date: _____

7.0 *MEDICAL MONITORING*

ERM personnel involved in field activities associated with this project will be active participants in the medical monitoring program. ERM has implemented a medical monitoring program that complies with the requirements of 29 CFR 1910.120.

Contractors and subcontractors to ERM will be required to adhere to the medical monitoring requirements of 29 CFR 1910.120 and provide documentation of compliance by completing the form shown in Figure 6-1 or through other appropriate means, or demonstrate exemptions from these requirements based on scheduled activities and work area characterization. An example of such an exemption would be a delivery driver who makes a delivery to the site in an area which has been characterized as having no contamination. Personnel required to participate in the medical monitoring program shall provide participation documents prior to site entry. It is unlikely that any field personnel will be exempt from the medical surveillance requirements.

Appendix B provides general information on medical monitoring.

8.0 SITE HAZARD CHARACTERIZATION/ANALYSIS

8.1 CHEMICAL EXPOSURE

Based on a review of the field activities defined in the SS Work Plan and contamination information from previous environmental surveys, the potential exists for significant exposure of project personnel to hazardous conditions arising from chemical contamination. Drilling activities will occur in areas near or in potential sources of contamination. During the sampling episodes, the most likely mechanism for chemical exposure is through skin contact with soil or groundwater contaminated with low levels of volatile organic compounds (VOCs), and metals. An additional potential exposure pathway is the inhalation of vapors or airborne particulates emanating from the boreholes. Table 8-1 presents a summary of the chemical, physical, and toxicological properties of potential environmental contaminants at MAS. Table 8-2 provides a hazard analysis for each site task and operation. For health concerns that employees may have, Material Safety Data Sheets (MSDSs) will be available in the ERM field trailer for review of all site containments.

A field organic vapor analyzer (OVA) will be used as a basis for defining the need for, and nature of, required PPE related to contact exposure and inhalation of VOC vapors. Management of risk associated with airborne particulates containing contaminants not detectable by an OVA will be accomplished by qualitative daily evaluation of wind speed and direction, with subsequent orientation of the work efforts to situate field personnel upwind of dust-generating equipment. Airborne particulates derived from drilling operations represent a potential exposure pathway only during drilling in the unsaturated zone. After contact with the groundwater, the entire length of the borehole will become saturated and particulates will be eliminated. To minimize generation of particulates while in the unsaturated zone, drill cuttings brought to the land surface will be moistened by misting/spraying using pressurized water bottles.

The equipment associated with each of the established levels of PPE are listed in Appendix C. Based on previous remedial investigation sampling efforts at MAS's, modified Level D protection is anticipated. Action levels of 5 parts per million (ppm) total VOCs above background will prompt reevaluation of the need for greater respiratory protection. In addition, generation of large quantities of potentially contaminated dust or other particulates will prompt reevaluation of respiratory protection. Dust

Table 8-1 Properties of Potential Environmental Contaminants Middletown Airfield Site

Contaminant *	OSHA PEL (TWA)	ACGIH TLV (TWA)	IDLH	C	Characteristics	Route of Exposure	Human Overexposure Symptoms	Target Organs
1,2 Dichlorethene (DCE)	1 ppm	5 ppm	4,000 ppm	No	Colorless liquid with a slightly acrid chloroform-like odor	Inhalation Ingestion Contact	Irritation of eyes, respiratory system, CNS depressent	Respiratory system, eyes, CNS
Trichloroethylene (TCE)	50 ppm	50 ppm	1,000 ppm	No	Colorless liquid unless dyed, chloroform-like odor	Inhalation Ingestion Contact	Headache, vertigo, nausea, tremors, sleepiness, visual disturbance, vomiting; dermatitis; eye irritation; cardiac arrythmias, paresthesias	Respiratory system, heart, liver, kidneys, CNS, skin
Vinyl chloride	1 ppm	5 ppm	NE	A-1	Colorless liquid with faintly sweet odor	Inhalation Ingestion Contact	Irration of the eyes, skin, mucous membrane; liver damage	Upper respiratory, skin, eyes, liver
Chlorobenzene	75 ppm	10 ppm	2,400 ppm	-	Colorless liquid with almond like odor	Inhalation Ingestion Contact	Irratation of skin, eyes, nose, drowsiness, incoherency	Respiratory system, eyes, skin, CNS, liver
1,2-1,3-1,4-Dichlorobenzene	75 ppm	75 ppm	1,000 ppm	Yes	Colorless white, crystalline solid with a pleasant aromatic odor	Inhalation Contact Ingestion	Eye irritation, swelling, rhinitis, anorexia, vomiting, low weight jaundice	
PCBs (Aroclor 1254) (Aroclor 1260) (Aroclor 1248)	0.5 mg/m^3	0.5 mg/m^3	5 ppm	No	Colorless to dark brown liquid; mild hydrocarbon odor	Inhalation Absorption Ingestion Contact	Eye irration; chloracne; liver damage	Skin, eyes, liver
Chromium	1 mg/m^3	0.5 mg/m^3	NE	No	Appearance and odor vary with compound	Inhalation Ingestion	Histologic fibrosis of lungs	Respiratory system, lungs

Table [illegible] Properties of Potential Environmental Contaminants
Middletown Airfield Site (Continued)

Contaminant *	OSHA PEL (TWA)	ACGIH TLV (TWA)	IDLH	C	Characteristics	Route of Exposure	Human Overexposure Symptoms	Target Organs
Lead **	0.05mg/m^3	0.15 mg/m^3	700 mg/m^3	No	Appearance and odor vary with compound	Inhalation Ingestion Contact	Lassitude, insomnia; pallor, eye grounds; anorexia, weight loss, malnutrition, constipation, abdominal pain, colic; hypotense, anemia; gingival lean line; tremors, wrist paralysis	GI, CNS, kidneys, blood, gingival tissue
Arsenic (Organic)	0.5 mg/m^3	0.2 mg/m^3	NE	Yes	Appearance and odor vary with compound	Inhalation Absorption Contact Ingestion	Ulceration of nasal septum, dermatitis, gastrointestinal disturbances, respiratory irritation.	Liver, kidneys, skin, lungs, lymphatic system
Cadmium	0.2 mg/m^3	0.01 mg/m^3	50 mg/m^3	No	Appearance and odor vary with compound	Inhalation Ingestion	Pulmonary edema, dsypnea, cough, tight chest, substernal pain; headache, chills, muscle aches; nausea, diarrhea, anosmia, emphysema, proteinuria, anemia	Respiratory system, lungs, kidneys, prostate, blood
Barium	0.5 mg/m^3	0.5 mg/m^3	1100 mg/m^3	No	Colorless to white crystals or a granular powder with a faint benealdehyde-like odor	Inhalation Ingestion Contact	Irritation to skin, eyes, mucous membrane; sensitive dermatitis	Skin, respiratory system, eyes

Table 8-1 Properties of Potential Environmental Contaminants Middletown Airfield Site (Continued)

Contaminant *	OSHA PEL (TWA)	ACGIH TLV (TWA)	IDLH	C	Characteristics	Route of Exposure	Human Overexposure Symptoms	Target Organs
Nickel	1 mg/m^3	1 mg/m^3	NE	A-1	Colorless to yellow liquid with musty odor	Inhalation Ingestion Contact	Causes nausea, vomitting stomach pain, cough, hpyerpnea, weakness delirium and convulsions	Lungs, paranasal sinus, CNS
Benzene	1 ppm	10 ppm	3,000 ppm	A-2	Colpr less liquid with aromatic odor	Inhalation Absorption Contact Ingestion	Eye, nose, respiratory irritant; giddiness; headache, nausea, staggered gait; fatigue, anorexia, lassitude; bone marrow depression; abdominal pain	Blood, CNS, skin, bone marrow, eyes, respiratory system
Toluene	100 ppm	50 ppm	2,000 ppm	No	Colorless liquid with aromatic odor	Inhalaton Absorption ingestion Contact	Fatigue, weakness; confusion, euphoria, dizziness, headache; dilated pupils, lacremation; nervousness, muscle fatigue, insomnia; paresthesis, dermatitis, photophobia	Eyes, upper respiratory system, skin, CNS
Xylene	100 ppm	100 ppm	1,000 ppm	No	Colorless liquid with aromatic odor	Inhalation Absorption Ingestion Contact	Dizziness, excitement, drowsiness, incoordination, staggered gait; irratation of eyes, nose, throat; conreal vacuolization, anorexia, nausea, vomiting, abdominal pain; dermatitis	CNS, eyes, GI tract, blood, liver, kidneys, skin

Table 3-1 Properties of Potential Environmental Contaminants
Middletown Airfield Site (Continued)

Contaminant *	OSHA PEL (TWA)	ACGIH TLV (TWA)	IDLH	C	Characteristics	Route of Exposure	Human Overexposure Symptoms	Target Organs
Methylene Chloride	500ppm	50ppm	5,000 ppm	A2	Colorless liquid with a chloroform like odor	Inhalation ingestion Contact	Fiatigue, weakness, sleepiness, light headed, numbness in the limbs, nausea, irritating to the eyes and skin.	Skin, CVS, eyes, CNS

Key:

C = Carcinogen
IDLH = Immediately Dangerous to Life and Health
PEL = Permissible Exposure Limit
TLV = Threshold Limit Value
TWA = Time Weighted Average
* = Material Safety Data Sheets available in ERM's field trailer for review by ERM employees
NE = No evidence could be found for the existence of an IDLH
ACGIH = American Conference of Governmental Industrial Hygienists
A-1 = Confirmed carcinogen by ACGIH
A-2 = Suspected carcinogen by ACGIH
A-3 = Animal carcinogen

** = The lead levels detected on site during previous RI/FS activities by NUS generally ranged from 7 to 30 ppm in soils. There were several exceedances of this range with the highest level being 335 ppm. The lead levels for the most part represent background conditions and are not indicative of a lead contamination problem. Based on the historical data and the shallow depth to ground water (5 to 8 feet), it is ERM's opinion that lead dust concentrations would be well below the OSHA Action Level for lead of 30 $\mu g/m^3$ and below the PEL of 50 ug/m^3.

Table 8-2 Potential Health and Safety Physical Hazards Associated with the Supplemental Studies at MAS

Potential Hazard	Description	Location	Procedure Used to Monitor/Reduce Potential Hazard
Heavy Equipment	Drill Rigs, Machinery	Throughout Site	Personnel maintain eye contact with operators; hard hats, safety shoes, and eye protection worn (as appropriate) during equipment operation.
Refuse and Materials	Construction refuse and construction materials	Throughout Site	Maintain clean work areas; dispose of refuse immediately; do not block access routes with materials.
Heat Producing / Electrical Equipment	Generators and Drill Rigs	Throughout Site	Operate equipment away from vegetation and other materials that may ignite. Maintain firefighting equipment in the vicinity of operating equipment.
Heat Stress and Cold Exposure	Personnel working under extreme temperature are subject to adverse temperature related effects	Throughout Site	Employ buddy system. Each worker is responsible for visually monitoring his/her partner for signs of heat stress/cold exposure. Site safety personnel will also monitor workers' conditions and establish work/rest regimens and recommend appropriate diet.
Chemical Exposure	Personnel can be exposed to various compounds associated with the site	Throughout Site	Follow guidelines in Safety Plan. Be familiar with signs and symptoms of exposure and first aid procedures. Report suspected over-exposure to supervisor immediately.
Soil & Aqueous Sampling	Handling sampling containers and sampling equipment, hand augers, and small engine gasoline - powered equipment will be used for collection of the sample.	Throughout Site	Employ the buddy system during all sampling procedures. All workers are to wear proper personal protective equipment. The workers shall handle the sampling equipment and containers with care and place items used during sampling in locations where they will not become a hazard.
Confined Spaces	Collection of grab sediment samples in the storm sewer.	Throughout Site	Employ the 3-person sampling team during all sampling procedures, two indivuduals in the work space, one at the top at ground level. All workers are to wear proper personal protective equipment. Communication should be maintained with third person at ground level. Combustible gas Indicator should be used to determine oxygen, Hydrogen Sulfide and Explosion limit levels prior to entering space and space should be purged continuously during activities. A confined space permit and checklist should be completed prior to entering the space.

generation will be controlled by applying a small amount of water from the USACE-approved water source. Refer to Table 8-3 for a summary of action levels and subsequent procedures.

All field staff will have full-face respirators equipped with organic cartridges available at all times during the drilling operations. These respirators will be put on if threshold organic vapor levels are exceeded, uncontrolled dust/particulates are encountered, or other signs of chemical exposure (headaches, nausea, dizziness) are noticed during drilling. The Field Operations Manager will have the responsibility to require the use of these respirators by ERM and subcontractor personnel. Skin contact will be minimized through the use of gloves during handling and sampling of potentially contaminated soil and groundwater samples.

8.2 *TRAFFIC*

All onsite personnel must take care to avoid motor vehicle accidents during drilling and sampling activities. The MAS posted speed limit will be obeyed at all times and seat belts will be worn both on and off site. ERM personnel and subcontractors will only drive on designated roads, except when performing necessary field work.

8.3 *BURIED UTILITIES*

Utility clearance shall be obtained from the local power company prior to intrusive activities being conducted. HIA personnel will also be notified prior to intrusive activities.

8.4 *WEATHER HAZARDS*

In the event of warm weather, personnel should be closely monitored for signs of heat stress or heat stroke, particularly if Tyvek® coveralls are required. In the event of cold weather, it may be necessary to protect personnel from the effects of cold temperatures and wind, as well as wetting from field operations or precipitation. More detailed discussion of the effects of and mitigating measures for temperature extremes is presented in Appendix D.

Table 8-3 ***Action Levels for Site Activities***
Middletown Airport Site

Instrument	Reading	Action
OVA (Organic Vapor)	Background to 5 ppm	Level D
	5 ppm to 250 ppm above background, sustained for 3 to 5 minutes	Level C with organic vapor or organic vapor/acid gas cartridges (Draw Draeger/Sensidyne tubes)
	Greater than 250 ppm	Evacuate
Draeger/Sensidyne Tubes (Benzene)	Background to 0.5 ppm	Level D
	Greater than 0.5 ppm up to 25 ppm	Level C with organic vapor or organic vapor/acid gas cartridges. One Benzene tube every 15 minutes to determine sustained concentration.
	25 ppm and above	Evacuate
0_2 Meter	Less than 19.5% oxygen	Evacuate
	19.5% to 22.0% oxygen	SCBA not intended on basis of 0_2 content only
	Greater than 22.0% oxygen	Evacuate, explosion hazard
LEL Meter (at the source)	Up to 5% LEL	Continue activity
	5% to 10% LEL	Continue activity, ID source
	Greater than 10% LEL	Evacuate, explosion hazard
Hydrogen Sulfide	Less than 10ppm	Level D
	Greater than 10ppm	Level B or Evacuate
Dust	Heavy visible emissions	Incorporate engineering controls (i.e., water, foam)

8.5 FIRE

Fire extinguishers will be provided to personnel on site. The extinguishers will be of the No. 10 ABC type approved by the National Board of Fire Underwriters. Extinguishers must be inspected by the Site Safety Officer or designee once a month thereafter. The prohibition against carrying matches, lighters, and spark producing equipment into the work area will be strictly complied with.

8.6 CONFINED SPACES

Confined Spaces, which will have personnel in them, must adhere to 29 CFR 1910.146. Briefly, this regulation mandates procedures and precautions to take when entering a confined space. Preventing people from entering a confined space is the best option, however, if a confined space must be entered the following precautions must be taken: measures must be implemented to prevent unauthorized entry; a Combustible Gas Indicator (CGI) and Organic Vapor Analyzer (OVA), Photovac Tip II or Microtip must be used to identify hazardous atmospheric conditions including explosive gases before entering the space, and a plan must be developed to implement the means, procedures, and practices necessary for safe permit space entry operations. These procedures and practices are discussed in Appendix F. A confined Space Entry Checklist must be completed by applicable field personnel prior to entering the confined space. A copy of the ERM Confined Space Entry Permit and Confined Space Entry Checklist can be found in Figure 8-1 and Figure 8-2, respectively. The Field Operations Manager/Site Safety Officer must review the permit and the checklist prior to any confined space work activities.

FIGURE 8-1

ERM
CONFINED SPACE ENTRY PERMIT

Date: _____ Shift: _____

ERM Dept. #: _____ Starting Time: _____ Expires: _____

Location and description of confined space: _____

Scheduled work to be done: _____

Person in charge of work: _____

Persons authorized to enter: _____

Special requirement	YES	NO	N/A		YES	NO	N/A
Lock out-tag out				Escape harness			
Lines capped/blanked				Tripod assembled			
Space Purged				Lifelines			
Ventilation				Fire extinguishers			
Secure area				Lighting			
Breathing apparatus				Protective clothing			
Communications device				Respirator			

* Do not enter unless all are checked YES or N/A

Test conducted	time/results	time/results	time/results
Oxygen 19.5 - <22.0%			
LEL <10%			
Hydrogen sulfide <10 ppm			
Unknown VOCs <50 ppm			

Instruments used:		Date:	Calibrator
CGI #	Calibrated		By
HNU #	Calibrated		By
OVA #	Calibrated		By

Emergency phone #s

Ambulance: Fire: Police:

Qualified Person/Signature: _____

Prepared by: _____

Reviewed by Entry Team Members: _____

All copies of permit will remain at the site until job is completed

Post at point of entry. Good for one shift only.

FIGURE 8-2

ERM
CONFINED SPACE ENTRY CHECKLIST

Pre-plan each job. This Confined Entry Checklist, when properly authorized, allows the person to whom it is issued to enter the area specified. The work shall not be started until the indicated signatures have been obtained, all requirements met, and any discrepancies corrected.

ENTRY CHECKLIST

(All applicable items shall be YES for the permit to be valid)	YES	NO	NOT APPLICABLE
1. Procedure provided, reviewed, and enforced?			
a. all job procedures reviewed and understood? Training Completed?			
b. Person onsite at all times to enforce all procedures?			
2. Welding, cutting, open flames present?			
3. Confined space isolated?			
a. Lock and Tag Procedure followed?			
b. Power sources *OFF*? Locked out?			
c. Electrical hazards isolated, removed, tagged?			
d. Rotating equipment locked out, removed, or disconnected?			
e. Lines carrying materials to and from confined space blanked off, section removed or locked by two valves and drained?			
Drain valve locked open and tagged?			
f. Contents removed and space flushed?			
4. Confined space atmosphere prepared and monitored?			
a. Purged?			
b. Flanges/access doors removed? Manholes opened?			
c. Continuous ventilation provided?			
d. Oxygen level maintained over 19.5% but less than 22%?			
e. Continuous air monitoring equipment provided? Operational?			
5. a. Personal protective equipment provided? Specific instructions given for its use?			
b. Air lines, self-contained breathing apparatus, or other approved respirators provided?			
c. Safety harness with "D" ring and life line provided?			
d. Head, hearing, hand, foot, and body protection provided?			
e. Lighting equipment of approved type provided and grounded?			
f. Fir extinguisher readily available?			
g. Walking/working surfaces protected from slippage?			
6. a. Attendant standing outside of space, trained and prepared to respond to emergencies as instructed?			
b. Rescue equipment provided at the confined space?			
c. Emergency alarms or communications available?			

NOTE: This list of items is not intended to be all inclusive, certain jobs may require additional specifications.

Signed: _____ _____

ERM Qualified Person — Date

9.0 ACCIDENT PREVENTION

General safety precautions and procedures applicable to all field investigations are outlined in Appendix F. The following sections present specific procedures which will be followed during the current investigation.

9.1 ON-SITE MONITORING

Field activities associated with the MAS investigation may create potentially hazardous conditions, such as the release of organic vapors into the breathing zone or contact with contaminated soils and water. As determined by the Site Safety Officer (SSO), most proposed site activities will involve continual monitoring of the ambient airspace in the work area by the SSO, or his qualified designee. Specialized activity-specific air monitoring will also be conducted (described below). As described in Section 8.1, an OVA, a flame ionization detector (FID) or a photo ionization detector (PID) will be used to monitor total VOC concentrations. The FID and the PID will be calibrated daily (or as instructed by manufacturer recommendations) with methane or isobutylene equivalents, respectively. For particulate material, monitoring will consist of wind speed and direction monitoring and subsequent work zone orientation to minimize particulate contamination. The FID and the PID will be calibrated using the following method:

Calibration of the OVA will be checked prior to and after each day's sampling program involving the instrument. Calibration will be performed using zero air and commercially available calibration gas. During the initial calibration check, if instrument response bias is greater than 5 percent (±5%) of the known vapor level of the calibration gas, the instrument will be calibrated according to the manufacturer's instructions. If the final calibration check at the end of a sampling day yields a percent bias greater than plus or minus 20 percent (±20%), then the data collected during the day should be qualified. Note that the knob on the control panel labeled "calibrate" is actually a scale offset adjustment and should be used only to set the zero or ambient air response. The instrument gain adjustment is located within the instrument housing.

The HNu Model 101 PID calibration will be checked prior to and after each day of use. Calibration will be performed using calibration gas obtained from HNu Systems or equivalent. During the initial calibration

check, if instrument response bias is greater than 5 percent of the known vapor concentration of the calibration gas, the instrument will be calibrated. If the final calibration check (at the end of a sampling day) yields a percent bias greater than plus or minus 20 percent, then the data collected during the day should be qualified.

For confined spaces, a Combustible Gas Indicator (CGI) will be used. Calibration of the CGI will be checked prior to and after each day's sampling program involving the instrument. Calibration will be performed using zero air, hydrogen sulfide gas and methane calibration gases. During the initial calibration check, if instrument response bias is greater than 5 percent (±5%) of the known vapor level of the calibration gas, the instrument will be calibrated according to the manufacturer's instructions. If the final calibration check at the end of a sampling day yields a percent bias greater than plus or minus 20 percent (±20%), then the data collected during the day should be qualified. Note that the knob on the control panel labeled "calibrate" is actually a scale offset adjustment and should be used only to set the zero or ambient air response. The instrument gain adjustment is located under the right-hand side cover of the CGI.

For particulate material, monitoring will consist of wind speed and direction monitoring and subsequent work zone orientation to minimize particulate contamination.

At the initiation of each work activity or work period, the SSO (or qualified designee) will measure and record the background levels of total VOCs in the ambient airspace. Additionally, relevant meteorologic data will be estimated and recorded in the project field book, with particular emphasis on wind speed, wind direction, relative humidity, and ambient air temperature. The potential for volatilization of VOCs will be assessed based upon the activity to be performed (intrusive versus non-intrusive), and the meteorologic conditions existing at the time the activity is to take place.

Air Monitoring During Drilling Operations

Air monitoring will be performed at each drilling location during the well installation and well development. An FID (Century® 128 OVA) or a PID (HNU Photovac® Tip II, or Microtip) will be utilized to monitor the breathing zone in the workspace surrounding the well location. The FID or PID will also be used to monitor the annular space of the well borehole and volatiles exiting all geologic soil samples (examined upon their retrieval). Similar monitoring of any fluids generated during well

installation/development will also be conducted, as directed by the SSO. The results will be recorded in the project field book.

Air Monitoring During Storm Sewer Sediment Sampling

Air monitoring will be performed prior to and during storm sewer sampling. An FID or PID and a CGI will be used to monitor the atmospheric conditions of the storm sewer prior to any employee entering the storm sewer, while in the storm sewer, and at ground level during work activities. Total VOC's, oxygen content, lower explosion limit, and hydrogen sulfide will be monitored.

A daily health and safety (i.e., air monitoring) log will be maintained by the SSO or his qualified designee. This log will include, at a minimum, the following information:

- Description of field work being conducted,
- Any changes in designed field methods,
- Names of all on-site field personnel,
- Types of air monitoring equipment being used,
- Equipment calibration methodologies,
- Air monitoring results,
- Level of PPE utilized, and
- Description of any unusual occurrences or physical complaints.

9.2 *TRAFFIC AND INCLEMENT-WEATHER DRIVING*

Personnel will adhere to all Commonwealth of Pennsylvania traffic regulations and exercise due caution, especially at peak traffic periods in the morning and evening. Seat belts must be worn at all times by all vehicle occupants while driving on the site. The Field Operations Manager will check daily weather reports and predictions to plan for appropriate precautions for traveling to and from the site. It is anticipated that the primary weather hazards will be related to precipitation in the form of snow or rain and low temperatures.

9.3 *WEATHER HAZARDS*

During the field drilling and sampling efforts, the following precautions will be taken:

1. Personnel will be observed closely for signs of heat stroke or heat stress (summer/fall), particularly if wearing Tyvek® coveralls;
2. Personnel will be observed for signs of hypothermia (fall/winter); and
3. Field operations will cease immediately upon signs of impending thunderstorms and lightning. The boom will be lowered to its transport position and the drill rig secured.

9.4 *DRILLING AND SOIL SAMPLING*

The Field Operations Manager will ensure that the following procedures are followed during drilling and sampling operations:

1. Hardhats will be worn at all times in the vicinity of the drilling rig;
2. Goggles or safety glasses will be worn when operating power tools, or entering work areas of MAS where they are required;
3. Heavy rubber boots with reinforced toes or steel-toe leather work boots with rubber overboots will be worn in the vicinity of the rig;
4. Outer work gloves must be worn over nitrile gloves to protect hands from cables, etc. These gloves should fit tightly to avoid getting caught in machinery;
5. Loose-fitting clothing or free long hair are not permitted near the rig;
6. Hands will be kept out of the way of moving parts of machinery when drilling is in progress;
7. Daily inspection of all ropes, cables, bolts, and moving parts of the rig is mandatory;
8. A first-aid kit and fire extinguisher will be available at all times;
9. Each field person will have an individual respirator available on site, and will be fully trained/certified in its use prior to arrival on site. This respiratory protection will be used only on an emergency basis as described in the following text. In the unlikely event that respiratory protection becomes necessary, all field staff will put on the respirators, and field equipment will be removed from the drilling/sampling site. Further work will be suspended until USACE

and ERM project staff confer and decide on specific PPE and real time air monitoring upgrades. The ERM Field Operations Manager will determine when conditions require a change from Modified Level B PPE (see Section 8.1);

10. The water supply available for drilling use will be maintained in a ready state to wash down any ERM or subcontractor personnel receiving significant accidental exposure to liquids or particulates emanating from the ground;

11. All crews will consist of at least two persons;

12. There will be no smoking on the site. Smoking outside of the site will only occur in designated smoking areas or inside vehicles. In no case will smoking materials or matches be disposed of on site, except in proper ashtrays;

13. No drilling will occur during impending electrical storms or when rain or icing conditions create a hazard in working with equipment; and

14. In the areas where utilities are located, water discharged during drilling/well development will be prevented from entering underground utilities manholes.

9.5 SEDIMENT SAMPLING STORM SEWERS

The Field Operations Manage will ensure that the following procedures are followed during sediment sampling:

1. Hardhats will be worn at all times;

2. Heavy rubber boots with reinforced toes or steel-toe leather work boots with rubber overboots will be worn;

3. Outer work gloves must be worn over nitrile gloves to protect hands from sharp metal in storm sewers, etc.. These gloves should fit tightly to avoid getting caught on any protruding metal in the storm sewers;

4. Calibration of all monitoring equipment will be done on a daily basis. Daily inspections of all ropes, cables, bolts, and moving parts or the tripod assembly is mandatory;

5. Testing of all communication equipment prior to entering space including construction trailer phone, to dial 911;

6. A first-aid and fire extinguisher will be available at all times;

7. Each field person involved in sediment sampling will have an individual SCBA available on site, and will be fully trained/certified in its use prior to arrival on site. Extra SCBA will be made available at ground level for emergency situations.

8. A water supply should be made in a ready state to wash down any ERM or subcontractor personnel receiving significant accidental exposure to liquids emanating from the storm sewer;

9. All crews will consist of at least three persons; two individuals will conduct the sampling and one individual will be at the top at ground level;

10. There will be no smoking in the storm sewer. Smoking outside the of the storm sewer will only occur in designated smoking areas or inside vehicles. In no case will smoking materials or matches be disposed of on site, except in proper ashtrays;

11. No sampling will occur during impending electrical storms or when rain or icing conditions create a hazard;

12. Continuous air monitoring should be conducted before and during all work activities;

13. A confined space permit and checklist must be completed prior to entrance to the storm sewer.

9.6 PERSONAL PROTECTIVE EQUIPMENT

Drilling and Soil Sampling

A. Coveralls, Tyvek® coveralls, or long-sleeved cotton shirts and long pants.

B. Outer chemical resistant gloves at a minimum for all material handling activities. Inner latex surgical gloves are recommended where practical.

C. Steel-toed leather boots or rubber overboots.

D. Options as required:

1. Disposable outer boots
2. Hard hat
3. Safety glasses
4. Hearing protection
5. Chemical-resistant gloves

Sediment Sampling

A. Coveralls, Tyvek® coveralls, or long-sleeved cotton shirts and long pants.

B. Outer chemical resistant at a minimum for all material handling activities. Inner latex surgical gloves are recommended where practical.

C. Steel-toed leather boots or rubber overboots

D. SCBA with extra bottles

E. Disposable outer boots

F. Hard hat

9.6.1 *Investigation Activities and Necessary Level of Personnel Protective Equipment*

The SSHP has been designed for modified Level D protection with a provision for emergency (escape) respiratory protection as the site conditions merit, with the exception of storm sewer sediment sampling. The Site Safety Officer is solely responsible for determining the levels of PPE to be used during on-site activities, and has the option to upgrade the level of PPE protection based on air monitoring results or if in contact with sampling media. The following is a list of site investigation activities and the PPE required.

Table 9-1
Investigation Activities and Necessary Levels of Personal Protection Equipment

Site Activity	Location	PPE Required
Soil sampling	See Field Sampling Plan	Modified Level D or as determined by SSO
Surface water and sediment sampling	See Field Sampling Plan	Modified Level D or as determined by SSO
Monitoring well installation (drilling subcontractor)	See Field Sampling Plan	Modified Level D or as determined by SSO
Purge water handling	See Field Sampling Plan (monitoring well locations)	Modified Level D or as determined by SSO
Sediment collection storm sewers	See Field Sampling	Level B

Basic emergency equipment (e.g., first aid kit, fire extinguisher, etc.) will also be available in the field vehicle(s) during the performance of all investigation activities. In addition, a gravity fed self-contained eyewash will be available. The eyewash station will be located in each field vehicle and will be accessible during field work activities. The portable eyewash will meet the requirements of ANSI 2358.1-1990, with a capacity of 0.4 gallons per minute for a minimum of 15 minutes.

10.0 CONTINGENCY PLANNING AND EMERGENCY RESPONSE

10.1 NOTIFICATION OF SITE EMERGENCIES

Medical personnel at the primary hospital will be briefed of site hazards and activities prior to project initiation so that potential emergency situations are dealt with efficiently.

In the event of any emergency, site personnel will immediately call 911. The nature and extent of the emergency will be clearly identified. Important emergency numbers are as follows:

Local Fire, Ambulance, Police		911
Pennsylvania State Police		911
Community General Osteopathic Hospital		(717) 652-3000
ERM Project Safety Supervisor (Joseph Baker)		(215) 524-3675
ERM Project Manager (Nick DeSalvo)	 HOME	(215) 524-3557 (215) 948-2093
USACE Project Officer (Dan Gillispie, P.E.)		(402) 221-7168
USAEC-Industrial Hygienist/ Safety Officer (Martha Boss)		(402) 221-7693

10.2 RESPONSIBILITIES

The Site Safety Officer will be responsible for responding to all emergencies. In the event that the Site Safety Officer is involved in the emergency, a designee will assume responsibility. Specific reporting responsibilities are as follows:

1. Notify appropriate individuals, authorities, and/or health care facilities of the activities and hazards of the emergency;

2. Ensure that the following safety equipment is available at the site: eyewash station, first aid supplies, and fire extinguishers;

3. Have working knowledge of all safety equipment available at the site; and

4. Ensure that a map which details the most direct route to the hospital is prominently posted with all necessary telephone numbers. At least one member of the field team will drive the route to the primary hospital before field work commences.

5. Ensure that all victims are decontaminated properly. Provide information on the contaminants of concern to first responders, transport personnel, and hospital personnel.

10.3 ACCIDENTS AND INJURIES

In the event of a safety or health emergency at the site, all in-place emergency measures will be activated immediately. The goal is to quickly and effectively assist those who have been injured or exposed and to protect others from the hazard(s). The Site Safety Officer (SSO) or his designee will be immediately notified and will respond according to the seriousness of the injury. The ERM Project Manager will be informed of any injuries, minor or serious, and will result in contractor transport to the hospital.

The SSO shall complete an Incident Report Form, Figure 10-1 as completely and as accurately as possible within four hours of the incident. The form shall be sent immediately to the Project Manager and to the Project Safety Supervisor.

Accidents resulting in a fatality, lost-time injury or illness, hospitalization of five or more personnel, or property damage to government or ERM property (which occurred during performance of the task order) equal to or exceeding $2,000.00 must be telephonically reported to USACE, (402) 221-7168, as soon as possible, but not later than two hours after occurrence, and reported in writing within two days of occurrence on ENG Form 3394 (Appendix G). All other accidents/incidents must be telephonically reported to USACE and USAEC-IH and S, (402) 221-7692, within two hours of occurrence.

FIGURE 10-1 *INCIDENT REPORT FORM*

CLIENT NAME: LOCATION OF INCIDENT:

DATE:

EMPLOYEE NAME: TYPE OF INCIDENT:

EMPLOYEE JOB TITLE:

SPECIFIC JOB AT TIME OF INCIDENT:

LEVEL OF PROTECTION WORN AT TIME OF EXPOSURE:

INCIDENT SUMMARY:

CORRECTIVE ACTIONS:

EMPLOYEE SIGNATURE:

SITE SAFETY OFFICER SIGNATURE:

ERM H&S COORDINATOR SIGNATURE:

TIME & DATE OF REPORT:

10.4 COMMUNICATIONS

A phone will be located at the construction trailer during on-site activities to facilitate emergency response and office communications. The phone will be tested daily (on-site) by calling Community General Osteopathic Hospital (717) 652-3000 and Airport Security (717) 948-3501. The location of buildings with telephones will be reviewed prior to initiation of field activities to provide back-up to the trailer phone.

10.5 TRANSPORT TO HOSPITAL

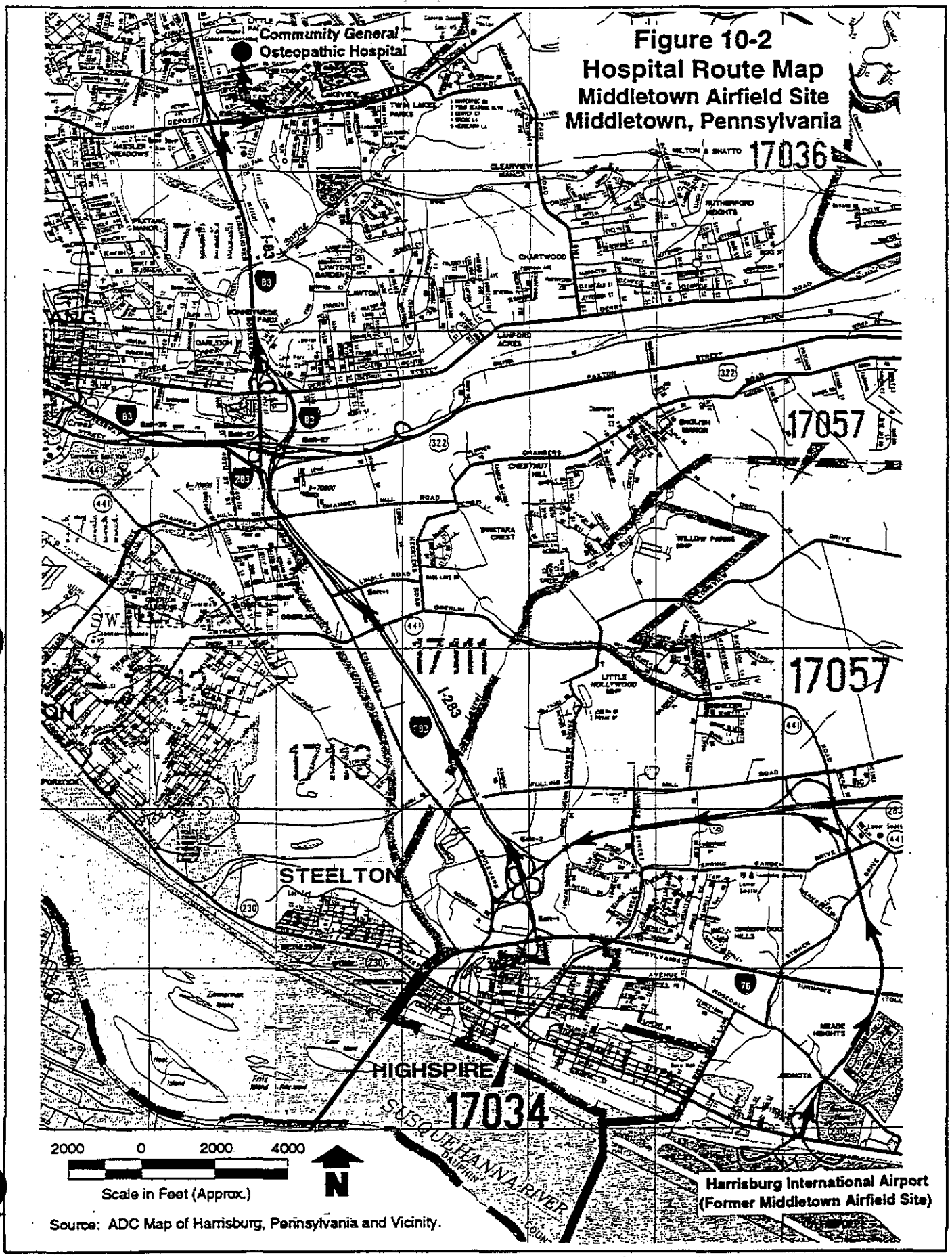
In the event of a serious injury requiring transport of on-site personnel to the designated hospital, an ambulance will be used. For minor injuries or illness, the Site Safety Officer may elect to have the affected person(s) transported to the hospital by company vehicle. If there is any doubt about the severity of the injury, a local ambulance will be used.

The anticipated transport route to the Community General Osteopathic Hospital is listed below and is shown in Figure 10-2:

1. Take Airport connector to 283 West;
2. Take 283 West to 283 North;
3. To 83 North;
4. Look for Exit 29 Union Deposit Road, make right turn bottom of ramp
5. First traffic light, make left
6. Next left Old Union Deposit Road
7. Look for Villa Road (go past Villa Teresa Nursing Home and up over hill
8. First stop sign make left onto Londonberry Road
9. Go to first stop sign and make right. Hospital straight ahead.
10. Emergency Room in back of hospital.

10.6 FIRE CONTROL

No smoking will be on the site; however, fire extinguishers (No. 10 ABC), buckets, and shovels will be available at drilling sites for use on small fires. All fires will be reported by calling 911 immediately. Smoking is not


Community General
Osteopathic Hospital
Figure 10-2
Hospital Route Map
Middletown Airfield Site
Middletown, Pennsylvania
17036
17057
17111
17057
17113
STEELTON
HIGHSPIRE
17034
I-283
2000 0 2000 4000
Scale in Feet (Approx.)
N
Source: ADC Map of Harrisburg, Pennsylvania and Vicinity.
Harrisburg International Airport
(Former Middletown Airfield Site)

AR303497

permitted in unoccupied areas or buildings, even though such locations are not marked as restricted.

10.7 *SPILL CONTROL*

The chances of a chemical spill at the site are minimal. In the event of a spill, the Field Operations Manager will notify the Fire Department at 911. The important precautions in the event of such a spill are that no personnel are overexposed to vapors, gases, or mists and that the liquid does not ignite. In addition, waste spillage must not be allowed to contaminate any local water source. Spill response equipment consisting of sorbent pads and booms, Speedi-dri, and extra drums will be maintained on-site to immediately respond to any release. Small dikes will be erected to contain spills, if necessary. Sorbent material will be used to soak up released fluids. Spent sorbents and affected soils will be removed and placed in drums for proper disposal. The Site Safety Officer will coordinate cleanup activities. Subsequent to cleanup activities, the SSO will survey the area to ensure that no toxic materials remain.

11.0 INSTALLATION RELATIONS/SECURITY REQUIREMENTS

Prior to field operations, the ERM Project Manager will be responsible for having this SSHP reviewed and approved by the USACE-IH and S.

12.0 *SAMPLE HANDLING AND TRANSPORT*

The following sample handling and transport procedures will be followed:

1. Samples will be packed with vermiculite in hard-sided plastic coolers to prevent breakage or sparks during transport;
2. Coolers will be sealed with custody tape prior to loading into transport vehicles;
3. Loading and unloading will be performed with due care to prevent breakage or dropping of samples;
4. Vehicles transporting equipment and field reagents (acids, bases) will not transport samples which are considered hazardous;
5. Vehicles transporting samples will carry a fire extinguisher and be kept in good repair (i.e., free from excessive grease and oil, fuel leaks, and having an exhaust system in good repair) to prevent contamination of the samples;
6. Vehicles transporting samples will not be left unattended at any time; and
7. Samples requiring transport to the designated analytical laboratory for analyses will be transported from MAS by a laboratory courier. Sample holding times will not be exceeded during transport.

13.0 WASTE DISPOSAL/DECONTAMINATION

Investigation derived wastes will be generated during the field investigations. Borehole cuttings, drilling fluid, and water evacuated from wells will be containerized and characterized for disposal. Equipment will be cleaned on the site at a designated decontamination pad and wash water collected for disposal. A USACE-approved water source will be used to supply the wash water. Used PPE, such as disposable gloves, will be containerized and disposal of along with soils at an off-site facility. Appendix H provides procedures for the decontamination of the anticipated PPE.

13.1 DECONTAMINATION PROCEDURES

All non-disposable equipment used for the collection, preparation, preservation, and storage of environmental samples must be cleaned prior to their use and after each subsequent use. Unless the equipment and materials being used are disposable or of sufficient number so as not to be reused during any one sampling period, decontamination will be conducted in the field. In order to prevent cross-contamination among sampling locations, all sampling equipment will be decontaminated as described below.

Before any equipment decontamination is conducted, a cleaning and decontamination area will be set up on the site. The cleaning area will be away from sources of contamination (such as exhaust fumes or dust, for example). A sheet of plastic or visqueen will be laid down, and equipment decontamination will be completed on the plastic sheet. Equipment that will be in contact with samples (such as bailers, split-spoon samplers, stainless steel spoons, hand augers, and trowel soil samplers) will be decontaminated. Decontaminated equipment (excluding decontaminated drilling equipment, backhoes, etc.) will be placed on aluminum foil, not on plastic.

Prior to arrival on-site, large equipment (such as drilling equipment, backhoes, etc.) will be steam cleaned. Drilling equipment, backhoes, etc. will be free from excess grease, oils, and caked-on soils from previous work prior to arrival at the site. Equipment which leaks fuel, coolant, and/or lubricants will be removed from the site and repaired prior to use.

The procedures for decontaminating sampling equipment will be as follows:

1. Clean with tap water and phosphate-free laboratory detergent (Liquinox® or equivalent) using a brush if necessary to remove particulate matter and surface films;
2. Rinse thoroughly with potable water;
3. Rinse with pesticide-grade methanol and allow to air dry for a minimum of 10 minutes;
4. Rinse three times with potable water;
5. Rinse thoroughly with deionized water and allow to air dry;
6. Wrap sampling equipment completely with aluminum foil, shiny side out, to prevent contamination if equipment id to be stored or transported;
7. Equipment such as pumps, flow lines, etc. will be flushed thoroughly with potable water prior to use;
8. Large equipment or materials not used immediately after decontamination will be placed on a plastic sheet, covered with plastic, and secured to avoid potential contamination; and
9. Clean, disposable gloves will be worm while handling sampling equipment during the final stages of decontamination. Pesticide-grade ispropanol and deionized water will be stored in glass containers and applied via Teflon® squeeze bottles.

14.0 LABORATORY SAFETY PROGRAM

Lancaster Laboratories of Lancaster, PA, and Mountain State Analytical, Inc. of Salt Lake City, Utah are ERM's designated analytical laboratories for the MAS. The Lancaster Laboratories Chemical Hygiene Plan is presented in its entirety in Appendix J.

Appendix A
Personnel Training

General site workers (such as equipment operators, general laborers and supervisory personnel) engaged in hazardous substance removal or other activities which expose or potentially expose workers to hazardous substances and health hazards shall receive a minimum of 40 hours of instruction off the site, and a minimum of three days actual field experience under the direct supervision of a trained, experienced supervisor. The training course must have included the following material at a minimum:

1. Safety and Health Officer and Site Management Responsibilities - personnel must understand Safety Officer and Site Management responsibilities and authority.
2. Site-Specific Health and Safety Hazards - personnel must be informed of specific hazards related to site and site operations.
3. Personal Protection Equipment (PPE) - personnel must be trained in proper use of personal protective equipment.
4. Safe Work Practices/Engineering Controls - personnel must be informed of appropriate work practices and engineering controls that will reduce the risk of exposure to site hazards.
5. Safety Equipment Use - personnel must understand the use of monitoring instruments and other safety equipment.
6. Medical Surveillance Program - personnel must be informed of requirements for medical surveillance of hazardous waste site employees.
7. Site Control Methods - personnel must understand site methods used to reduce exposure to on-site and off-site personnel.
8. Decontamination Procedures - personnel must be trained in proper decontamination operations and procedures.
9. Emergency Response - personnel must be trained in proper emergency response operations and procedures.
10. Confined Space Entry/Special Hazards - personnel involved in specific hazardous activities, such as confined space entry and drum handling, must receive training in appropriate techniques to employ during such operations.

Workers on site only occasionally for a specific limited task (such as, but not limited to, ground water monitoring, land surveying, or geophysical surveying) and who are unlikely to be exposed over permissible exposure

limits and published exposure limits shall receive a minimum of 24 hours of instruction off the site, and the minimum of one day actual field experience under the direct supervision of a trained, experienced supervisor.

Workers regularly on site who work in areas which have been monitored and fully characterized indicating that exposures are under permissible exposure limits where respirators are not necessary, and the characterization indicates that there are no health hazards or the possibility of an emergency developing, shall receive a minimum of 24 hours of instruction off the site and the minimum of one day actual field experience under the direct supervision of a trained, experienced supervisor.

Workers with 24 hours of training who meet the criteria for 24-hour training cited above, and who become general site workers or who are required to wear respirators, shall have the additional 16 hours and two days of training necessary to total the training specified for the 40-hour training criteria.

On-site management and supervisors directly responsible for, or who supervise employees engaged in, hazardous waste operations shall receive 40 hours initial training, and three days of supervised field experience [the training may be reduced to 24 hours and one day if the only area of their responsibility is employees covered by 29 CFR 1910.120 paragraphs (e)(3)(ii) and (e)(3)(iii)] and at least eight additional hours of specialized training at the time of job assignment on such topics as, but not limited to, the employer's safety and health program and the associated employee training program, personal protective equipment program, spill containment program, and health hazard monitoring procedure and techniques.

Annual refresher training consisting of eight hours of instruction is required of all employees, managers and supervisors who have completed the initial specified training requirements for working on-site as indicated in 29 CFR 1910.120 (e)(8).

Health and safety training programs shall comply with criteria set forth by ERM and OSHA as per final regulation 29 CFR 1910.120. This program will instruct employees on general health and safety principles and procedures, proper operation of monitoring instruments, and use of personal protective equipment.

In addition, site employees will undergo site-specific training prior to the start-up of any given project or task. As activities change at a particular

site, related training will address potential hazards and associated risks, site operating procedures, emergency response and site control methods to be employed.

Hazard communication training will be conducted onsite to address those chemicals brought onsite by ERM. Topics for training would include awareness of hazards, preventive measures, sources of information, Material Safety Data Sheets (MSDSs), and labeling.

Specialized training will be provided as dictated by the nature of site activities. Specialized training will be provided for activities such as confined space entry, excavations and handling of unidentified substances. Employees involved in these types of activities will be given off-site instruction regarding the potential hazards involved with safety activities and the appropriate health and safety procedures to be followed. Off-site instruction is meant to include any area where employees will not be exposed to site hazards.

This Site Safety and Health Plan must be distributed to all subcontractors prior to the start of field activities. A pre-operation meeting will be held to discuss the contents of the Plan. Specialty training will be provided as determined by task and responsibility. All training of personnel will be conducted under direct supervision of a trained Health and Safety Officer or his designee.

Exemptions from training may be approved by the Health & Safety Officer in conjunction with the Project Manager.

A copy of the OSHA Poster No. 2203, Notice of Employee Rights, will be posted at all times in the ERM field office.

Appendix B
Medical Monitoring

The Occupational Safety and Health Administration (OSHA) has established requirements for a medical surveillance program designed to monitor and reduce health risks for employees potentially exposed to hazardous materials (29 CFR 1910.120). This program has been designed to provide baseline medical data for each employee involved in hazardous waste operations including field activities, and to determine his/her ability to wear personal protective equipment, such as chemical resistant clothing and respirators. Employees who wear or may wear respiratory protection must be provided respirators as regulated by 29 CFR 1910.134. This standard requires that an individual's ability to wear respiratory protection be medically certified before he/she performs designated duties. Where medical requirements of 29 CFR 1910.120 overlap those of 29 CFR 1910.134, the more stringent of the two will be enforced.

The medical examinations must be administered on a pre-employment and annual basis and as warranted by symptoms of exposure or specialized activities. These examinations shall be provided by employers without cost or loss of pay to the employee. For the purposes of this Health and Safety Plan, all subcontractors shall assume the employer's responsibility in obtaining the necessary medical monitoring and training for their employees pursuant to this section of 29 CFR 1910.120.

The medical examinations shall include the following:

A. Medical History and Physical, Including:
   - Medical questionnaire.
   - Completion of medical history with occupational risk factor analysis.
   - Examination by physician.
   - Evaluation of test results.
   - Brief report sent to employer covering specific requested areas as well as pertinent positive findings; report sent to family physician and employee by request.

B. Pulmonary Function Testing (FEV_1, FVC)

C. EKG (12-lead)

D. Lab tests, Including
   - Urinalysis

- Blood Chemzyme Analysis (Chem 18)
- Coronary Risk Screen
- Complete Blood Count with differential

E. Audiometric testing - Supervised by Board-Certified Staff Otolaryngologist

F. Visual Acuity and Tonometry - Supervised by Board-Certified Staff Ophthalmologist

The examining physician is required to make a report to the employer of any medical condition which would place such employees at increased risk of wearing a respirator or other personal protective equipment. Each employer engaged in site work shall assume the responsibility of maintaining site personnel medical records as regulated by 29 CFR 1910.120 where applicable.

Basically, an employee is required by federal regulations to have medical monitoring if the employee is or may be exposed to hazardous substances or health hazards at or above the permissible exposure limits for these substances, without regard to the use of respirators, for 30 days or more a year.

All employers contracted to work at the site designated by this Plan will be responsible to ensure their employees have received the proper medical tests as regulated by 29 CFR 1910.120 and shall provide the contractor with certification of same.

Appendix C
Personal Protection Levels & Associated Equipment

C.1 PROTECTIVE EQUIPMENT

All personnel must be provided with appropriate personal safety equipment and protective clothing. Each individual will be properly trained in the use of this safety equipment before the start of field activities. Safety equipment and protective clothing shall be used as directed by the Site Safety Officer. All such equipment and clothing will be cleaned and maintained in proper condition by project personnel. The Site Safety Officer will monitor the maintenance of personnel protective equipment to ensure proper procedures are followed.

Personal protective equipment will be worn at all times, as designated by the Health and Safety Plan. Levels of protective clothing and equipment have been assigned to specific work tasks.

The personal protective equipment levels designated below are in conformance with EPA criteria for Level A, B, C, and D protection. All respiratory protective equipment used will be approved by NIOSH/MSHA. Standard operating procedures for respiratory protection can be found in ERM's written respiratory program available upon request from the ERM field office.

C.2 LEVEL A PROTECTION

A. Equipment listed for Level B Protection.

B. Fully-encapsulating suit.

C.3 LEVEL B PROTECTION

A. Pressure demand cascade air-line system or other suitable self-contained, pressure demand breathing apparatus.

B. Chemical-resistant clothing such as Poly-coated Tyvek® or Saranex®. Suits will be one piece with booties and elastic wrist bands.

C. Outer nitrile and inner latex surgical gloves.

D. Leather boots with rubber overboots.

E. Water-resistant tape over protective clothing as necessary.

F. Hard Hat.

G. Options as required:

1. Coveralls
2. Disposable outer boots
3. Face shield
4. Escape mask
5. Hearing protection

NOTE: A "Certificate of Analysis" will be submitted to the onsite Corp of Engineer representative verifying supplied air for respirators meets the minimum "Grade D" air characteristics.

C.4 LEVEL C PROTECTION

A. Full-face or half-face air purifying respirator equipped with appropriate organic vapor/dust canisters or cartridges.

B. Chemical-resistant clothing such as Tyvek®, Poly-coated Tyvek® or Saranex®. Suits will be one piece with hoods, booties, and elastic wrist bands.

C. Outer nitrile gloves and inner latex surgical gloves.

D. Leather boots with rubber overboots.

E. Hard Hats.

F. Safety Glasses

G. Options as required:

1. Coveralls
2. Disposable outer boots
3. Escape Mask
4. Face shield
5. Hearing protection
6. Water-resistant tape

C.5 MODIFIED LEVEL D PROTECTION

A. Level D protection and options as required:

1. Tyvek®, Poly-coated Tyvek®, or Saranex® - coated Tyvek® suit
2. Outer nitrile gloves

3. Inner latex surgical gloves
4. Disposable outer boots

B. Level C protection readily available.

C.6 *LEVEL D PROTECTION*

A. Coveralls, cotton shirts, and long pants.

B. Steel-toed leather boots.

C. Level C protection readily available.

D. Options as required:

1. Hard hat
2. Safety glasses
3. Hearing protection

Appendix D
Temperature Extreme Guidelines

HEAT STRESS

The following should be used as guidelines in controlling heat stress. The Site Safety Officer has the responsibility to monitor heat stress throughout each day and to make work/rest recommendations as appropriate. All workers are expected to follow the work/rest cycles.

Heat stress decisions will be based mostly on physiological measurements (pulse rate, skin temperature) and environmental measurements by the WBGT monitors. All equipment necessary to monitor WBGT will be maintained on site in the event it is required. Additional environmental data will also be recorded daily and considered in heat stress evaluations.

Initially, work/rest cycles will be established using pulse rates and the following guidelines. This work/rest schedule may be modified at the discretion of the Site Safety Officer. The work/rest schedule and daily protocols are based upon guidance set by the ACGIH along with the professional judgment of the responsible ERM Industrial Hygienist. The WBGT readings in this table are actual readings - no additional factors should be added:

WORK/REST SCHEDULE

WBGT (°C)			
LEVEL C&B	MOD C	LEVEL D	WORK/REST
<22.5	<24	<25.8	NORMAL
22.5-24.4	24-25.9	25.8-27.5	60-15
24.5-26.4	26-27.9	27.6-29.6	45-15
26.5-29.4	28-30.9	29.7-32.5	30-30
29.5-30.4	31-31.9	32.6-33.5	15-45
30.5-32	32-33.5	33.6-35.2	15-60
>32	>33.5	>35.2	CEASE WORK

DAILY PROTOCOL

- WBGT Readings will be taken:
  - at the beginning of the work day
  - mid-morning
  - noon
  - mid-afternoon
  - at the end of the work day

- WBGT readings will be taken at least at each drilling rig, other major work areas and at outside rest stations.
- Employee body weights (semi-nude) will be taken immediately before work and at the end of the work day. If the weight loss exceeds 1.5%, the worker should be told to drink more liquids during that evening and the following work days. The worker will also be monitored during the next few work days to insure the weight loss does not continue at an unacceptable rate.
- Pulse rates will be monitored routinely throughout the workday, frequency depending upon WBGT readings. At minimum, the most active member of each work crew will be monitored during the first two breaks in the morning and the first break after lunch.
- Pulse rates will be taken as follows:
  - at the end of a cycle of work, the worker goes to a nearby location and sits on a stool or straight chair. At the moment he is seated the observer starts a stopwatch. At 30 seconds the observer begins a pulse count, having previously palpate the radial pulse. This count is continued until one minute. The 30-second count is multiplied by 2 and recorded as "P_1"
  - if P_1 exceeds 120, an additional pulse will be taken starting at 2 minutes, 30 seconds to 3 minutes; multiplied by 2 and recorded as P_3.
- Pulse rates readings:
  - 120 and below (P_1) - Worker will be allowed to continue the scheduled work/rest cycle.
  - Exceeding 120 (P_1) - Worker will remain in the rest area until pulse rate returns to 90, or below; additional monitoring will depend upon the pulse rate recovery.
- Pulse rate recovery - for individual with P_1 greater than 120.

Patterns	P_3	P_1-P_3
Satisfactory (S)	<90	-
High (H)	≥90	≥10
No recovery (N)	≥90	<10

- Satisfactory patterns need no further comment.
  - High recovery patterns indicate work at a high metabolic level with little or no accumulated body heat. Individuals showing this condition should be monitored during the next breaks while work periods are reduced until P1 is 120 or below.

- No recovery patterns indicate too much personal stress. Individuals showing "no recovery" heart rate patterns return to the decon trailers and rest for a period no less than one hour. Site Health and Safety Officer must monitor the workers and determine if additional medical assistance is needed.

- Fluid intake should be encouraged for workers throughout the day. Workers should frequently drink small amounts; the equivalent of one cup every 15-20 minutes. Workers should also be encouraged to salt their food abundantly.

- Acclimatization to heat involves a series of physiological and psychological adjustments that occur in an individual during the first week of exposure to hot environments. For this reason, the following work schedule applies for workers new to the site when conditions are such that controlled work/rest cycles are being used:

		Suggested Maximum Work
Day 1	-	2 hours
Day 2	-	3 hours
Day 3	-	4 hours
Day 4	-	6 hours
Day 5	-	8 hours

Deviations from this schedule may be done based on evaluations by the Site Safety Officer.

HEAT STRESS

Effects of heat stress can occur as either heat exhaustion, or the more dangerous condition of heat stroke. Signs of heat exhaustion include pale, clammy skin, profuse perspiration, and extreme fatigue. There may be headache or vomitting. The body temperature will appear normal. Effects of heat stroke include hot, flushed or red, dry skin with extremely high body temperature, up to 41°C (106°F). The victim may experience dizziness, nausea, headache, rapid pulse or unconsciousness.

COLD EXPOSURE

Personnel working outdoors in low temperatures are subject to cold exposure. Toes, fingers, ears, cheeks, and the nose are especially vulnerable to cold exposure.

Factors influencing the development of a cold injury include ambient temperature, wind velocity, humidity, type of exposure, and duration of exposure. Frostbite and hypothermia are two cold injuries which may occur.

Frostbite is a local injury resulting from cold exposure. It is characterized by a white or pale coloring of the skin. Its symptoms are exhibited in the following stages:

- Just before frostbite occurs, the affected skin may be slightly flushed;
- The skin changes to white or grayish-white in appearance;
- Pain is sometimes felt early but subsides later (often there is no pain).
- Blisters may appear later;
- The affected part feels intensely cold and numb;
- The victim frequently is not aware of frostbite.

The objectives of first aid are to protect the frozen area from further injury, to warm the affected area rapidly, and to maintain respiration.

Hypothermia is an overall cooling of the body. Its symptoms are usually exhibited in five stages:

- Shivering;
- Apathy, listlessness, sleepiness;
- Unconsciousness, glassy stare, slow pulse, and slow respiratory rate;
- Freezing of the extremities; and
- Death.

To avoid cold exposure injuries, personnel should dress in layers, removing clothing as they generate heat from working. The buddy system must be instituted to ensure signs of frostbite or hypothermia will be noted as soon as possible. Generally, it is easier for someone else to see these signs before the person who is exhibiting them will notice. A work/rest regimen, designated by the Site Safety Officer should be implemented early to avoid personnel casualties. If any cold exposure injuries are detected, the Site Safety Officer must be notified immediately.

Appendix E
Special Precautions and Procedures

The site poses potential exposure risks from both chemical and physical hazards. The chemical risks have been explained in detail in the HASP. The potential for chemical exposure to hazardous substances is significantly reduced through the use of personal protective clothing, engineering controls, and implementation of safe work practices.

Other potential hazards that are associated with the site activities include working around heavy equipment, heat stress or cold exposure (depending on time of year), and site debris. Precautionary measures have been established to reduce these risks to a minimum during site activities.

E.1 HEAT STRESS/COLD EXPOSURE

It is not anticipated that heat stress will be a significant factor in the health and safety of the workers. However, if heat stress does become a significant factor, work/rest regimens will be employed as necessary so that personnel do not suffer adverse effects from heat stress. Special clothing and an appropriate diet and fluid intake will be recommended to all site personnel to further reduce these temperature-related hazards. The work/rest regimens will be developed following the guidelines in the ACGIH, Threshold Limit Values and Biological Exposure Indices for 1990-1991 and other practices developed and used by experienced industrial hygienists.

Effects of heat stress can occur as either heat exhaustion, or the more dangerous condition of heat stroke. Signs of heat exhaustion include pale, clammy skin, profuse perspiration, and extreme fatigue. There may be headache or vomiting. The body temperature will appear normal. Effects of heat stroke include hot, flushed or red, dry skin with extremely high body temperature, up to 41°C (106°F). The victim may experience dizziness, nausea, headache, rapid pulse or unconsciousness.

The effects of cold exposure can be less apparent to the victim. It is extremely important that partners within the buddy system visually inspect their fellow workers often. Redness of the skin indicates the onset of cold exposure. A white or pale skin color, especially on extremities such as the nose, cheeks, chin, ears, fingers, and toes are indications that frostbite is setting in. Individuals should dress in layers, peeling off each layer as they get warmer from exertion. The Site Safety Officer should

keep informed of the wind-chill factor and be inspecting workers during cold exposure conditions.

E.2 *HEAVY MACHINERY/EQUIPMENT*

All site employees must remain aware of those site activities that involve the use of heavy equipment and machinery. Respiratory protection and protective eyewear may be worn during site activities. This protective equipment significantly reduces peripheral vision of the wearer. Therefore, it is essential that all employees at the site exercise extreme caution during operation of equipment and machinery to avoid physical injury to themselves or others.

E.3 *CONSTRUCTION MATERIALS AND SITE REFUSE*

All construction materials and site refuse (spoil material) should be contained in appropriate areas or facilities. All trash and waste materials will be immediately and properly disposed of. It is important to maintain clear areas of egress in case of an emergency.

E.4 *ADDITIONAL SAFETY PRACTICES*

The following are important safety precautions which will be enforced during the remedial activities when contact with waste materials is possible:

1. Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of material is prohibited in any area designated as contaminated.
2. Hands and face must be thoroughly washed upon leaving the work area and before eating, drinking, or any other activity.
3. Whenever decontamination procedures for outer garments are in effect, the entire body should be thoroughly washed as soon as possible after departing the site. At a minimum, personnel will be required to wash face and hands thoroughly prior to departing the site.
4. No excessive facial hair which interferes with the effectiveness of a respirator will be permitted on personnel required to wear respiratory protection equipment. The respirator must seal against the face so that the wearer receives air only through the air purifying cartridges attached to the respirator. Fit testing shall be performed prior to respirator use to ensure a proper seal is obtained by the wearer.

5. Contact with potentially contaminated surfaces should be avoided whenever possible. One should not walk through puddles, mud, or other discolored surfaces; kneel on ground; lean, sit or place equipment on drums, containers, vehicles, or the ground.

6. Medicine and alcohol can potentiate the effect from exposure to certain compounds. On-site personnel should consult with their physician regarding the use of prescribed drugs during investigation activities.

7. Personnel and equipment in the work areas should be minimized, consistent with effective site operations.

8. Work areas for various operational activities should be established.

9. Procedures for leaving the work area must be planned and implemented prior to going to the site. Work areas and decontamination procedures must be established on the basis of prevailing site conditions.

10. Respirators will be issued for the exclusive use of one worker and will be cleaned and disinfected after each use by the worker.

11. Safety gloves and boots shall be taped to the disposable, chemical protective suits as necessary.

12. All unsafe equipment left unattended will be identified by a "DANGER DO NOT OPERATE" tag.

13. The Department of the Army requires hearing protection any time noise levels exceed 85 decibels (dBA). Disposable, form-fitting plugs are preferred.

14. Cartridges for air-purifying respirators in use will be changed as directed by the Site Safety Officer. Cartridges will be replaced whenever the wearer experiences breathing resistance or breakthrough.

15. Self-contained breathing apparatus (SCBA) and air-purifying respirators will be inspected by the Site Safety Officer, as necessary dependent upon use.

16. All activities in the exclusion zone will be conducted using the "Buddy System". The Buddy is another worker fully dressed in the appropriate PPE, who can perform the following activities:

- Provide his/her partner with assistance;
- Observe his/her partner for signs of chemical or heat exposure;
- Periodically check the integrity of his/her partner's PPE; and
- Notify others if emergency help is needed.

Appendix F
Confined Space Entry

Confined Space Entry Program
Environmental Resources Management, Inc.

February 1994

Environmental Resources Management, Inc.
855 Springdale Drive
Exton, Pennsylvania 19341

TABLE OF CONTENTS

1.0 APPLICATION

This policy sets forth the accepted practice for entry into a confined space and establishes the requirements for administering its procedure. This procedure applies to ERM, Inc. (ERM) employees who may be working in a confined space area. ERM personnel are prohibited from entering any confined space as described below without authorization from a qualified member of the ERM Health and Safety group.

2.0 PURPOSE

The intent of this procedure is to provide information and guidance to ensure that a consistent, safe approach is instituted each time a confined space is entered. Confined spaces are those areas that are large enough to enter and perform work, have limited means for entry or exit, and are not designed for continuous occupancy. It is very important that personnel understand their role during confined space entry operations due to the significant and numerous hazards posed by such activities.

3.0 AUTHORITY

This policy is based on The Occupational Safety and Health Administration's (OSHA) standard (Title 29, Section 1910.146), regulating entry into confined spaces.

4.0 CONFINED SPACE ENTRY

There are certain characteristics of confined spaces that must be recognized and/or evaluated in order to enter such spaces properly. General confined space characteristics include:

- Areas that are large enough for an employee to enter and perform an assigned job
- Has limited or restricted means to enter or exit
- Is not designed for continuous occupancy

The OSHA standard focuses on those confined spaces that require an entry permit due to the hazards posed by the operation. A Permit-Required Confined Space has any of the following, additional characteristics:

- Contains or may contain a hazardous atmosphere;
- Contains a material that has the potential for engulfing an entrant;
- Is configured in a way that could trap or asphyxiate an entrant;
- Contains any other recognized serious safety or health hazard;

Some examples of a permit-required confined space may include storm and sanitary sewers, sumps, tanks, or any number of similar spaces. The determination of general and permit required confined spaces will be made by a qualified member of the ERM Health and Safety group.

If the only hazard posed in a permit-required confined space is an actual or potential hazardous atmosphere, and this hazard can be eliminated by continuous forced air ventilation alone, then this space can be considered to be a low-hazard confined space. If there are no hazards posed by the confined space, then this space can be considered to be a non-permit confined space.

The standard requires an evaluation of the workplace and identification of permit-required confined spaces. The existence and location of these spaces, and the dangers they pose, must be known to all exposed employees. A qualified ERM Health & Safety Group member must be contacted to determine the appropriate confined space designation and appropriate confined space entry procedures.

5.0 *ENTRY PERMIT PROGRAM*

The OSHA standard also requires a written program for entry into permit-required confined spaces. This ERM Confined Space Entry Program, in conjunction with the site-specific Health & Safety Plan, satisfies this requirement. The program includes the following elements:

- Preventing unauthorized entry — such as the use of covers, guardrails, fences, locks, or whatever means are necessary.
- Identifying and evaluating hazards before entry — such as hazardous atmospheres, engulfment hazards, hazardous energy sources, introduction of hazardous chemicals, or hot work.
- Implementing safe entry procedures:
- Specifying acceptable entry conditions (for example, carbon monoxide level <35 ppm)

Action levels will be included within the health and safety plan. If there are any questions about these levels or the use of them, the field team leader shall contact a qualified member of the ERM Health & Safety Group.

- Isolating the space (for example, lockout/tagout, line breaking, etc.)

ERM personnel shall not be responsible for isolating the space. This is the responsibility of the client. It is, however, the responsibility of the ERM field team leader to ensure that the isolation has taken place and that a review of the isolation procedure has been conducted with the client.

- Purging the space to control atmospheric hazards

The safest method of space purging is natural ventilation. If this method is not possible, an electrical or gasoline-powered ventilation fan can be used. Potentially explosive atmospheres must not be pulled through the ventilation fan unless the fan is designated as explosion-proof. Ideally, positive ventilation should be used. This involves fresh air pumped into the space and the contaminated air exhausted out.

- Providing barriers to protect entrants from external hazards

The field team leader shall ensure that consideration has been given with regard to the entire confined space, not just the entrance. The field team leader and/or site safety officer will fully investigate potential hazardous conditions. At the entrance, caution tape and/or traffic cones shall be placed to prevent unauthorized entry near the entrance. If an entrance cover is removed, the opening shall be guarded by a railing, temporary cover, or other temporary barrier that will prevent an accidental fall through the opening. Heavy equipment, such as front-end loaders and trucks shall be prohibited from the confined space vicinity.

- Verifying acceptable entry conditions throughout entry (periodic inspections and atmospheric testing)

A qualified member of the ERM Health & Safety Group must ensure that the proper equipment is on-site and that the on-site user of the equipment has had the proper training in the use of the equipment. The field team leader must ensure that the equipment is in operational condition, that the equipment has been calibrated, and that the equipment is being used correctly.

- Providing necessary equipment for testing and monitoring

On-site personnel shall have, at a minimum, the following monitoring instrument:

- Oxygen meter,
- Combustible gas indicator, and
- Toxic gas monitors for anticipated contaminants

In addition to having the piece of equipment on-site, the field team leader shall also ensure that appropriate calibration span gas and equipment, and equipment instructions are included.

- Ventilating

Where necessary, ventilation equipment shall be used to flush contaminated air out of the space. Unless explosion proof, the ventilation equipment shall not be used to pull air through the fan. If ventilation equipment is not available and the atmosphere is hazardous, supplied air respiratory protection shall be used. Under no circumstances will entry into a confined space where combustible gases exceed 10% of the lower explosive limit be allowed.

- Communicating

The entrant and the attendant must have at least one method of communicating while confined space operations are in progress. Methods of communication include the following:

- Speaking
- Two-way Radio
- Hand signals
- Horn or other audible signals
- Light signals
- Life line tugs
- Written message

During confined space operations brevity of message is one of the best ways to improve communications. In spoken communication, this is accomplished by avoiding unnecessary words and by using a standardized set of words and phrases.

The use of two way radios can cause a frustrating, ineffective communication between the entrant and the attendant. Some methods that may be helpful include:

- The person called is always followed by the person doing the calling. For example: "Attendant, this is entrant."
- The word "over" can be used at the end of a transmission to denote the end of that transmission. This lets the receiver know when the sender has stopped speaking and is waiting for a reply. This also prevents dual transmission, in which communication breaks down.
- The word "out" can be used to indicate the end of the conversation. This prevents either party from needlessly waiting for additional transmissions.
- Speak slowly, loudly, and clearly. It may seem uncomfortable to speak in such a manner, but the message has a much better probability of being understood.
- Try to reduce the number of words, thereby reducing the probability of the message being misunderstood. For example, the message, "The water level is down as far as we can get it; go ahead and shut down the pump - over," becomes, "Stop pump - over."
- Personal protection

A health and safety plan must be completed for all ERM field work. If the confined space operation is not already a part of the health and safety plan, the ERM Health & Safety Group must prepare an attachment to the plan, addressing the confined space entry operation. Within the plan, there will be a list of PPE required. The entrant must be equipped with all listed PPE.

- Lighting

Lighting shall be either external to the confined space, or it shall be configured in such a way as to prevent accidental breakage. If the atmosphere has the potential to be explosive, the lighting equipment must be explosion-proof.

- Ingress/egress

The confined space entrant may enter the space only when given permission by the field team leader. The field team leader must ensure that a qualified member of the ERM Health & Safety Group has been contacted for guidance. If a confined space entry permit is required, the field team leader shall ensure that no entry is made until all appropriate checks have been accomplished in accordance with the confined space entry permit.

During egress, the attendant shall assist the entrant by preventing air line hoses, wire life lines, electrical chords, and other encumbrances from cluttering the egress route or snagging as the entrant leaves the confined space.

- Rescue and emergencies

Only trained and authorized employees may attempt a rescue which necessitates confined space entry. The attendant **may not** enter the space to attempt a rescue unless the attendant has been trained and certified in confined space entry rescue, is wearing appropriate personal protective equipment, **and has been properly relieved as attendant.**

ERM has full body harnesses, a tripod, and a winch assembly. This retrieval equipment, when properly used, is designed to effect a rescue in a vertical confined space. Because of the serious personal injury that may result with the inappropriate use of this equipment, only trained personnel are authorized to use the rescue equipment.

- Evaluating conditions when entry operations are conducted:
  - Testing to determine if acceptable entry conditions exist before entry is authorized
  - Testing to determine if acceptable entry conditions exist throughout the entry

The confined space entry permit shall be kept in the project file for a period of one year.

5.1 *TRAINING AND DUTIES OF THE ENTRY SUPERVISOR*

Personnel who authorize entry into permit-required confined spaces, known as "Entry Supervisors," must ensure proper procedures are followed prior to and during confined space operations. Additionally, these individuals must remain aware of ongoing conditions during operations so that appropriate decisions can be made. Supervisors must receive training and instruction in their duties and responsibilities regarding confined space entry. The following are assigned duties:

- Ensure entry permit is completed and accurate
- Ensure proper procedures and equipment are used

- Monitor conditions during the confined space operations for changes that would affect entrants. A change in condition may require the Entry Supervisor to halt operations and remove entrants from the confined space until hazards are controlled
- Close-out the permit and return the confined space to its intended use
- Verify, by checking that the appropriate entries have been made on the permit, that all tests specified by the permit have been conducted and that all procedures and equipment specified by the permit are in place before endorsing the permit and allowing entry to begin. The entry supervisor will be designated in the site specific health and safety plan.

5.2 *TRAINING AND DUTIES OF AUTHORIZED ENTRANTS*

Entrants must have training and instruction in their duties and responsibilities regarding confined space entry. The following are assigned duties:

- Identify and evaluate hazards which may be present prior to and during a confined space operation;
- Review the job at hand with each member of the confined space entry team prior to entry;
- Maintain contact and communications with the attendant;
- Use the personal protective equipment provided;
- Maintain awareness of all external barriers required to protect from external hazards, e.g., blanking, blocking, lockout, etc., and the use of those barriers;
- Review entry operations when there is reason to believe existing measures may not protect entrants;
- Obey evacuation orders given by either the attendant, automatic alarm activation, or when self-perceived;

Entrants will be designated in the site-specific health and safety plan.

5.3 *TRAINING AND DUTIES OF ATTENDANTS*

Attendants are the critical link between those entering the confined space and those outside the confined space who would provide necessary assistance in the event of an emergency. Attendants must have training

and instruction in their duties and responsibilities regarding confined space entry. The following are assigned duties:

- Continuously monitor the progress of the confined space operation to ensure the safety of the entrants. In the event of an emergency, the attendant must resist the urge to rescue entrant personnel until additional assistance arrives on the scene. **Attendants DO NOT enter a confined space and attempt rescue unless additional personnel are on hand and the attendant is trained to do so!;**
- Recognize hazards and take corrective action;
- Order evacuation of the confined space if an uncontrolled hazard develops, either within or outside the space, or upon observing a behavioral effect of hazard exposure among entrants;
- Keep unauthorized personnel away from the permitted confined space work area. Entrants are to be informed of any unauthorized personnel entering the confined space.

Entrants will be designated in the site-specific health and safety plan.

5.4 *ATMOSPHERIC TESTING*

Prior to entering any confined space and/or prior to removing any covering (e.g., manhole covers) on a confined space, the confined space atmosphere must be monitored for combustible gases, oxygen levels, and toxic vapors or gases. The following is the sequence and acceptable air quality criteria that testing must follow:

- Oxygen content (19.5-23%) for all confined space entry;
- Combustible gas levels below 10%;
- Contaminate concentrations at or below PEL/TLV where compound is known (SCBA are required where compounds are unknown) or where contaminant concentrations exceed the capacity of air purifying respirators.

Those identified confined space areas having the potential for oxygen deficient, combustible, or toxic atmospheres will require that levels be measured and recorded on the Confined Space Entry Permit.

ERM's instrument technician calibrates field monitoring equipment in accordance with manufacturers' instructions. The field team leader shall ensure that the organic vapor meters has been calibrated within the past 3 weeks and that the combustible gas indicators have been calibrated within the past month. The Photovac Microtip is cleaned and charged prior to

issue. The field team leader shall ensure that the instrument is calibrated in the field using the appropriate span gas. Calibration information shall be noted, at a minimum, in the field team leader's field book.

6.0 *PERSONAL PROTECTIVE EQUIPMENT AND EMERGENCY EQUIPMENT*

The supervisor authorizing entry into a confined space (entry supervisor) is responsible to ensure that appropriate personal protective equipment (PPE) is available at the site and that it is used when necessary. PPE includes:

- respiratory protection
- protective clothing
- head protection
- eye and face protection
- hearing protection
- body harnesses and associated retrieval lines

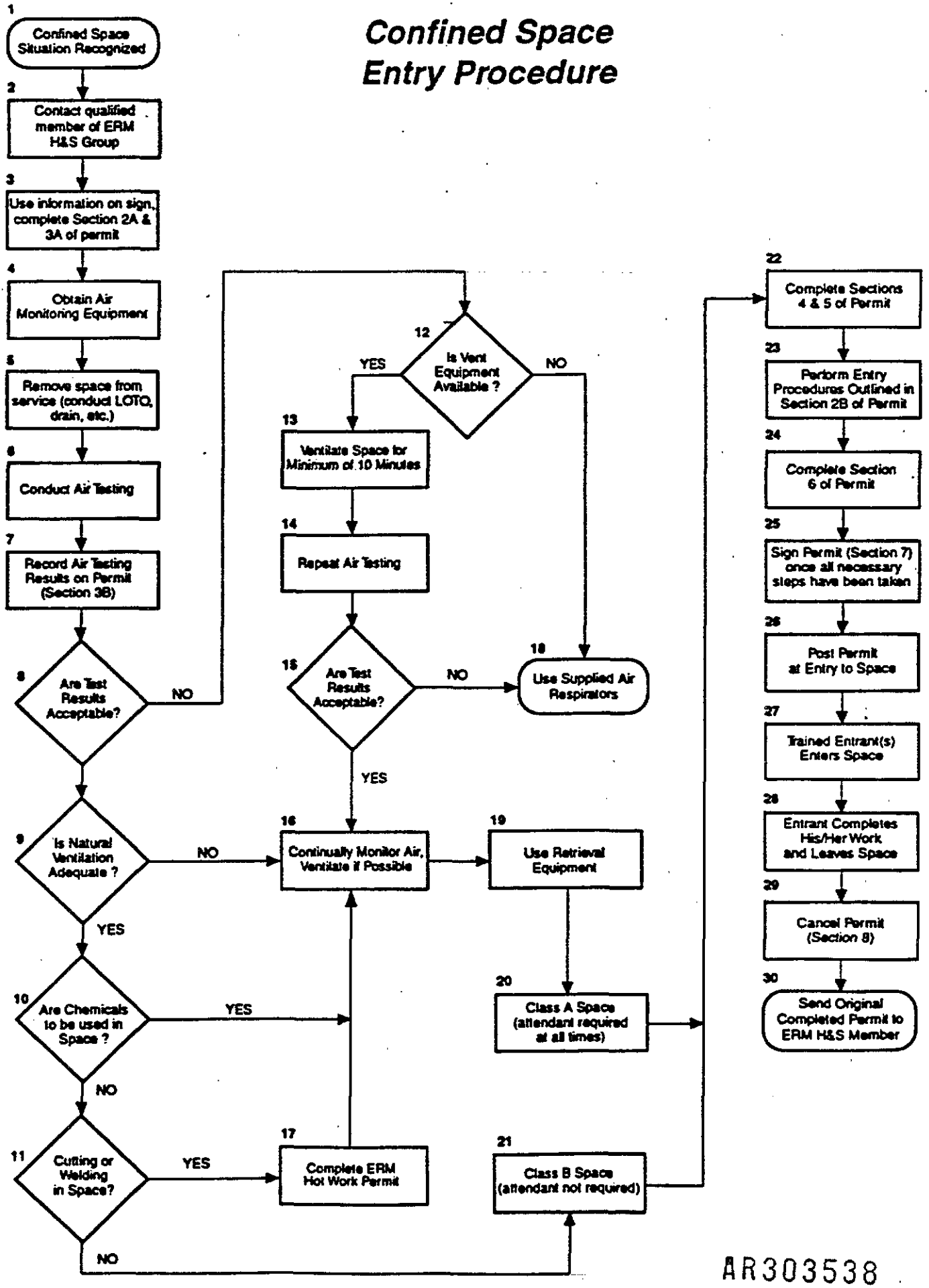
Two major types of respiratory protection equipment are available from ERM; air-purifying and air-supplying. Air-purifying respirators include disposable and non-disposable cartridge or filter-type respirators. These units filter out contaminants and allow the user to breathe filtered air. Air-purifying respirators can be worn in a confined space to filter out contaminants, but only after the atmosphere has been tested and is found to be within the limits of the respirator (i.e., half-face is allowed up to ten times PEL). Remember the limitations of the air-purifying respirator; they are not to be worn in an oxygen-deficient atmosphere, are not to be used if excessive concentrations of toxic gases or vapors are present, not to be worn in conditions that are immediately dangerous to life or health or IDLH, and they should not be worn during most rescue operations.

If oxygen deficiency, high concentrations of toxic gases and vapors, or excessive dusts exist in a confined space, supplied-air respirators must be used. Supplied-air respirators provide the user with a constant supply of breathing quality air. Supplied-air respirators that are available include Self-Contained Breathing Apparatus (SCBA) and airline respirators with equipped with escape bottles. Supplied-air respirators provide the highest level of respiratory protection for entry

7.0 CONCLUSION

Confined space fatalities and injuries are, for the most part, preventable. The most important step in fatality and injury prevention is hazard recognition. All ERM, Inc. field personnel must be able to recognize a confined space entry situation and contact a qualified member of the ERM Health & Safety Group for further instruction. Since every situation is unique, this confined space policy has not attempted to address every conceivable possibility. It is imperative, then, that the field team's senior member work closely with the ERM Health & Safety Group to ensure that proper entry procedures are followed. Project schedules, budget limitations, and worker convenience shall never take higher priorities than worker safety. Failure to comply with the provisions of this confined space entry policy are grounds for immediate dismissal from ERM.

Confined Space Entry Procedure



Appendix G
Accident Investigation Report (ENG Form 3394)

(For Safety Staff only)	REPORT NO.	EROC CODE	UNITED STATES ARMY CORPS OF ENGINEERS ACCIDENT INVESTIGATION REPORT (For Use of this Form See Attached Instructions and USACE Suppl to AR 385-40)	REQUIREMENT CONTROL SYMBOL: CEEC-S-8(R2)

1. ACCIDENT CLASSIFICATION

GOVERNMENT	(1) INJURY/ILLNESS/FATAL	(2) PROPERTY DAMAGE	(3) MOTOR VEHICLE INVOLVED	(4) DIVING
[redacted] CIVILIAN ☐ MILITARY →	☐	☐ FIRE INVOLVED ☐ OTHER	☐	☐
[redacted] CONTRACTOR →	☐	☐ FIRE INVOLVED ☐ OTHER	☐	☐
c. PUBLIC →	☐ FATAL ☐ OTHER		☐	

2. PERSONAL DATA

a. NAME (Last,First,MI)	b. AGE	c. SEX ☐ MALE ☐ FEMALE	d. SOCIAL SECURITY NUMBER	e. GRADE

f. JOB SERIES/TITLE	g. DUTY STATUS AT TIME OF ACCIDENT	h. EMPLOYMENT STATUS AT TIME OF ACCIDENT
	(1) ☐ ON DUTY (2) ☐ TDY (3) ☐ OFF DUTY	[redacted] ☐ PERMANENT ☐ SEASONAL ☐ STUDENT ☐ TEMPORARY ☐ FOREIGN NATIONAL ☐ VOLUNTEER ☐ OTHER (Specify)

3. GENERAL INFORMATION

a. DATE OF ACCIDENT (month/day/year)	b. TIME OF ACCIDENT (Military time)	c. EXACT LOCATION OF ACCIDENT	d. CONTRACTOR'S NAME
/ /	/ /		(1) PRIME:

e. CONTRACT NUMBER	f. TYPE OF CONTRACT	g. HAZARDOUS/TOXIC WASTE ACTIVITY	(2) SUBCONTRACTOR:
# ☐ CIVIL WORKS ☐ MILITARY ☐ OTHER	☐ CONSTRUCTION ☐ SERVICE ☐ A/E ☐ DREDGE ☐ OTHER (Specify)	☐ SUPERFUND ☐ DERP ☐ IRP ☐ OTHER (Specify)	

4. CONSTRUCTION ACTIVITIES ONLY *(Fill in line and corresponding code number in box from list - see instructions)*

a. CONSTRUCTION ACTIVITY	(CODE)	b. TYPE OF CONSTRUCTION EQUIPMENT	(CODE)
	#		#

5. INJURY/ILLNESS INFORMATION *(Include name on line and corresponding code number in box for items e, f & g - see instructions)*

a. SEVERITY OF INJURY	b. ESTIMATED DAYS LOST	c. ESTIMATED DAYS HOSPITALIZED	d. ESTIMATED DAYS RESTRICTED DUTY
[redacted] (1) ☐ FATAL (2) ☐ LOST- TIME (3) ☐ NON LOST -TIME (4) ☐ FIRST AID			

e. BODY PART AFFECTED	(CODE)	g. TYPE AND SOURCE OF INJURY	(CODE)
PRIMARY	#	TYPE	#
SECONDARY	#		
f. NATURE OF INJURY	#	SOURCE	#

6. PUBLIC FATALITY *(Fill in line and corresponding code number in box - see instructions)*

a. ACTIVITY AT TIME OF ACCIDENT	(CODE)	b. PERSONAL FLOATATION DEVICE USED?
	#	☐ YES ☐ NO ☐ NA

7. MOTOR VEHICLE ACCIDENT

a. TYPE OF VEHICLE	b. TYPE OF COLLISION	c. SEAT BELTS	USED	NOT USED	NOT AVAILABLE
☐☐ PICKUP/VAN ☐☐ AUTOMOBILE ☐☐ TRUCK ☐☐ OTHER (Specify)	☐ HEAD ON ☐ REAR END ☐ BACKING ☐ BROADSIDE ☐ SIDE SWIPE ☐ ROLL OVER ☐ OTHER	(1) FRONT SEAT			
		(2) REAR SEAT			

8. PROPERTY/MATERIAL INVOLVED

a. NAME OF ITEM	b. OWNERSHIP	c. $ AMOUNT OF DAMAGE
(1)		
(2)		
(3)		

9. VESSEL/FLOATING PLANT ACCIDENT *(Fill in line and corresponding code number in box from list - see instructions)*

a. TYPE OF VESSEL/FLOATING PLANT	(CODE)	b. TYPE OF COLLISON/MISHAP	(CODE)
	#		#

10. ACCIDENT DESCRIPTION *(Use additional paper, if necessary)*

[redacted]

AR303540

11. CAUSAL FACTOR(S) *(Read Instruction Before Completing)*

a. *(Explain YES answers in Item 13)*	YES	NO
DESIGN. Was design of facility, workplace or equipment a factor?	☐	☐
INSPECTION/MAINTENANCE. Were inspection & maintenance procedures a factor?	☐	☐
PERSON'S PHYSICAL CONDITION. In your opinion, was the physical condition of the person a factor?	☐	☐
OPERATING PROCEDURES. Were operating procedures a factor?	☐	☐
JOB PRACTICES. Were any job safety/health practices not followed when the accident occurred?	☐	☐
HUMAN FACTORS. Did any human factors such as, size or strength of person, etc., contribute to accident?	☐	☐
ENVIRONMENTAL FACTORS. Did heat, cold, dust, sun, glare, etc., contribute to the accident?	☐	☐

a. *(CONTINUED)*	YES	NO
CHEMICAL AND PHYSICAL AGENT FACTORS: Did exposure to chemical agents, such as dust, fumes, mists, vapors or physical agents, such as, noise, radiation, etc., contribute to accident?	☐	☐
OFFICE FACTORS. Did office setting such as, lifting office furniture, carrying, stooping, etc., contribute to the accident?	☐	
SUPPORT FACTORS: Were inappropriate tools/resources provided to properly perform the activity/task?	☐	
PERSONAL PROTECTIVE EQUIPMENT: Did the improper selection, use or maintenance of personal protective equipment contribute to the accident?	☐	☐
DRUGS/ALCOHOL: In your opinion, was drugs or alcohol a factor to the accident?	☐	☐

b. WAS A WRITTEN JOB/ACTIVITY HAZARD ANALYSIS COMPLETED FOR TASK BEING PERFORMED AT TIME OF ACCIDENT?

☐ YES *(If yes, attach a copy.)* ☐ NO

12. TRAINING

a. WAS PERSON TRAINED TO PERFORM ACTIVITY/TASK?	b. TYPE OF TRAINING.	c. DATE OF MOST RECENT FORMAL TRAINING.
☐ YES ☐ NO	☐ CLASSROOM ☐ ON JOB ☐ NONE	/ / *(Month) (Day) (Year)*

13. FULLY EXPLAIN WHAT ALLOWED OR CAUSED THE ACCIDENT; INCLUDE DIRECT AND INDIRECT CAUSES *(See instruction for definition of direct and indirect causes.) (Use additional paper, if necessary)*

a. DIRECT CAUSE

b. INDIRECT CAUSE(S)

14. ACTION(S) TAKEN, ANTICIPATED OR RECOMMENDED TO ELIMINATE CAUSE(S).

DESCRIBE FULLY

15. DATES FOR ACTIONS IDENTIFIED IN BLOCK 14.

a. BEGINNING *(Month/Day/Year)* / / b. ANTICIPATED COMPLETION *(Month/Day/Year)* / /

c. SIGNATURE AND TITLE OF SUPERVISOR COMPLETING REPORT	d. DATE *(Mo/Da/Yr)*	e. ORGANIZATION IDENTIFIER *(Div, Br, Sect.)*	f. OFFICE SYMBOL
CORPS _____	___ / ___ / ___		
CONTRACTOR _____	___ / ___ / ___		

16. MANAGEMENT REVIEW *(1st).*

a. ☐ CONCUR b. ☐ NON CONCUR c. COMMENTS

SIGNATURE	TITLE	DATE

17. MANAGEMENT REVIEW *(2nd - Chief Operations, Construction, Engineering, etc.)*

a. ☐ CONCUR b. ☐ NON CONCUR c. COMMENTS

SIGNATURE	TITLE	DATE

18. SAFETY AND OCCUPATIONAL HEALTH OFFICE REVIEW

a. ☐ CONCUR b. ☐ NON CONCUR c. ADDITIONAL ACTIONS/COMMENTS:

SIGNATURE	TITLE	DATE

19. COMMAND APPROVAL

COMMENTS

COMMANDER SIGNATURE	DATE

AR303541

GENERAL. Complete a separate report for each person who was *injured, caused,* or *contributed* to the accident (excluding uninjured personnel and witnesses). Use of this form for reporting USACE employee first-aid type injuries *NOT* to be submitted to the Department of Labor (DOL), *Office of Workers' Compensation Programs* (OWCP) [redacted] be at the discretion of the FOA Commander. Please type or print [redacted]. Appropriate items shall be marked with an "X" in the box(es). If [redacted]onal space is needed, provide the information on a separate sheet and attach to the completed form. Ensure that these instructions are forwarded with the completed report to the designated management reviewers indicated in sections 16. and 17.

INSTRUCTIONS FOR SECTION 1 — ACCIDENT CLASSIFICATION. *(Mark All Boxes That Are Applicable.)*

a. GOVERNMENT. Mark "CIVILIAN" box if accident involved government civilian employee; mark "MILITARY" box if accident involved U.S. military personnel.

(1) INJURY/ILLNESS/FATALITY — Mark if accident resulted in any government civilian employee injury, illness, or fatality that requires the submission of Office of Workers Compensation Programs (OWCP) Forms CA-1 (injury), CA-2 (illness), or CA-6 (fatality), to the Department of Labor OWCP, or military personnel lost-time or fatal injury.

(2) PROPERTY DAMAGE — Mark the appropriate box if accident resulted in any damage of $1000 or more to government property (including motor vehicles).

(3) VEHICLE INVOLVED — Mark if accident involved a motor vehicle, *regardless of whether* "INJURY/ILLNESS" or "PROPERTY DAMAGE" are marked.

(4) DIVING ACTIVITY — Mark if the accident involved an in-house USACE diving activity.

b. CONTRACTOR.

(1) INJURY/ILLNESS/FATALITY — Mark if accident resulted in any contractor lost-time injury/illness or fatality.

[redacted] PROPERTY DAMAGE — Mark the appropriate box if accident resulted in any damage of $1000 or more to contractor property (including motor vehicles).

(3) VEHICLE INVOLVED — Mark if accident involved a motor vehicle, regardless of whether "INJURY/ILLNESS" or "PROPERTY DAMAGE" are marked.

(4) DIVING ACTIVITY — Mark if the accident involved a USACE Contractor diving activity.

c. PUBLIC.

(1) INJURY/ILLNESS/FATALITY — Mark if accident resulted in public fatality. (The "OTHER" box will be marked when requested by the FOA to report an unusual non-fatal public accident that could result in claims against the government or as otherwise directed by the FOA Commander).

(2) VOID SPACE — Make *no entry.*

(3) VEHICLE INVOLVED — Mark if accident resulted in a fatality to a member of the public and involved a motor vehicle, *regardless* of whether "INJURY/ILLNESS" is marked.

(4) VOID SPACE — Make no entry.

INSTRUCTIONS FOR SECTION 2 — PERSONAL DATA

a. NAME — (MANDATORY FOR GOVERNMENT ACCIDENTS. *OPTIONAL AT THE DISCRETION OF THE FOA COMMANDER* FOR CONTRACTOR AND PUBLIC ACCIDENTS). Enter last name, first name, middle initial of person involved.

b. AGE — Enter age.

[redacted]EX — Mark appropriate box.

[redacted] SOCIAL SECURITY NUMBER — (FOR GOVERNMENT PERSONNEL ONLY) Enter the social security number (or other personal identification number if no social security number issued).

e. GRADE — (FOR GOVERNMENT PERSONNEL ONLY) Enter pay grade. Example: O-6; E-7; WG-8; WS-12; GS-11; etc.

f. JOB SERIES/TITLE — For *government civilian employees* enter the pay plan, full series number, and job title, e.g. GS-0810/Civil Engineer. For *military personnel* enter the primary military occupational specialty (PMOS), e.g., 15A30 or 11G50. For *contractor employees enter the job title assigned to the injured* person, e.g. carpenter, laborer, surveyor, etc.,

g. DUTY STATUS — Mark the appropriate box.

(1) ON DUTY — Person was at duty station during duty hours or person was away from duty station during duty hours but on official business at time of the accident.

(2) TDY — person was on official business, away from the duty station and with travel orders, at time of accident.

(3) OFF DUTY — person was not on official business at time of accident.

h. EMPLOYMENT STATUS — (FOR GOVERNMENT PERSONNEL ONLY) Mark the most appropriate box. If "OTHER" is marked, specify the employment status of the person.

INSTRUCTION FOR SECTION 3 — GENERAL INFORMATION

a. DATE OF ACCIDENT — Enter the month, day, and year of accident.

b. TIME OF ACCIDENT — Enter the local time of accident in military time. Example: 1430 hrs (not 2:30 p.m.).

c. EXACT LOCATION OF ACCIDENT — Enter facts needed to locate the accident scene. (installation/project name, building number, street, direction and distance from closest landmark, etc.,).

d. CONTRACTOR NAME

(1) PRIME — Enter the exact name (title of firm) of the prime contractor.

(2) SUBCONTRACTOR — Enter the name of any subcontractor involved in the accident.

e. *CONTRACT NUMBER — Mark the appropriate box to identify if* contract is civil works, military, or other: if "OTHER" is marked, specify contract appropriation on line provided. Enter complete contract number of prime contract, e.g., DACW 09-85-C-0100.

f. TYPE OF CONTRACT — Mark appropriate box. A/E means architect/engineer. If "OTHER" is marked, specify type of contract on line provided.

g. HAZARDOUS/TOXIC WASTE ACTIVITY (HTW) — Mark the box to identify the HTW activity being performed at the time of the accident. *For Superfund, DERP, and Installation Restoration* Program (IRP) HTW activities include accidents that occurred during inventory, predesign, design, and construction. For the purpose of accident reporting, DERP Formerly Used DoD Site (FUDS) activities and IRP activities will be treated separately. For Civil Works O&M HTW activities mark the "OTHER" box.

INSTRUCTIONS FOR SECTION 4 — CONSTRUCTION ACTIVITIES

a. CONSTRUCTION ACTIVITY — Select the *most appropriate* construction activity being performed at time of accident from the list below. Enter the activity name and place the corresponding code number identified in the box.

CONSTRUCTION ACTIVITY LIST

1. MOBILIZATION
2. *SITE PREPARATION*
3. EXCAVATION/TRENCHING
4. GRADING (EARTHWORK)
5. PIPING/UTILITIES
6. FOUNDATION
7. FORMING
8. CONCRETE PLACEMENT
9. STEEL ERECTION
10. ROOFING
11. FRAMING
12. MASONRY
13. CARPENTRY
14. ELECTRICAL
15. SCAFFOLDING/ACCESS
16. MECHANICAL
17. PAINTING
18. EQUIPMENT/MAINTENANCE
19. TUNNELING
20. WAREHOUSING/STORAGE
21. PAVING
22. FENCING
23. SIGNING
24. LANDSCAPING/IRRIGATION
25. INSULATION
26. DEMOLITION

6. TYPE OF CONSTRUCTION EQUIPMENT—Select the equipment involved in the accident from the list below. Enter the name and place the corresponding code number identified in the box. If equipment is not included below, use code 24, "OTHER", and write in specific type of equipment.

CONSTRUCTION EQUIPMENT

1. GRADER
2. DRAGLINE
3. CRANE (ON VESSEL/BARGE)
4. CRANE (TRACKED)
5. CRANE (RUBBER TIRE)
6. CRANE (VEHICLE MOUNTED)
7. CRANE (TOWER)
8. SHOVEL
9. SCRAPER
10. PUMP TRUCK (CONCRETE)
11. TRUCK (CONCRETE/TRANSIT MIXER)
12. DUMP TRUCK (HIGHWAY)
13. DUMP TRUCK (OFF HIGHWAY)
14. TRUCK (OTHER)
15. FORKLIFT
16. BACKHOE
17. FRONT-END LOADER
18. PILE DRIVER
19. TRACTOR (UTILITY)
20. MANLIFT
21. DOZER
22. DRILL RIG
23. COMPACTOR/VIBRATORY ROLLER
24. OTHER

INSTRUCTIONS FOR SECTION 5—INJURY/ILLNESS INFORMATION

a. SEVERITY OF INJURY—Mark the appropriate box

(1) FATAL—injured person died or is missing and presumed dead.

(2) LOST TIME—a non-fatal injury that causes any loss of time from work beyond the day or shift in which it occurred or a non-fatal illness/disease that causes disability at any time.

(3) NO LOST TIME—a non-fatal, traumatic injury that does not cause loss of time from work beyond the day or shift in which it occurred.

(4) FIRST AID—One time treatment (and/or one follow visit for observation) for minor scratches, cuts and similar injuries that do not ordinarily require medical attention.

b. ESTIMATED DAYS LOST—Enter the estimated number of workdays the person will lose from work.

c. ESTIMATED DAYS HOSPITALIZED—Enter the estimated number of workdays the person will be hospitalized.

d. ESTIMATED DAYS RESTRICTED DUTY—Enter the estimated number of workdays the person, as a result of the accident, will not be able to perform all of their regular duties.

e. BODY PART AFFECTED—Select the most appropriate primary and when applicable, secondary body part affected from the list below. Enter body part name on line and place the corresponding code letters identifying that body part in the box.

GENERAL BODY AREA	CODE	BODY PART NAME
ARM/WRIST	AB	ARM AND WRIST
	AS	ARM OR WRIST
TRUNK, EXTERNAL MUSCULATURE	B1	SINGLE BREAST
	B2	BOTH BREASTS
	B3	SINGLE TESTICLE
	B4	BOTH TESTICLES
	BA	ABDOMEN
	BC	CHEST
	BL	LOWER BACK
	BP	PENIS
	BS	SIDE
	BU	UPPER BACK
	BW	WAIST
	BZ	TRUNK OTHER
HEAD, INTERNAL	C1	SINGLE EAR INTERNAL
	C2	BOTH EARS INTERNAL
	C3	SINGLE EYE INTERNAL
	C4	BOTH EYES INTERNAL
	CB	BRAIN
	CC	CRANIAL BONES
	CD	TEETH
	CJ	JAW
	CL	THROAT, LARYNX
	CM	MOUTH
	CN	NOSE
	CR	THROAT, OTHER
	CT	TONGUE
	CZ	HEAD OTHER INTERNAL
ELBOW	EB	BOTH ELBOWS
	ES	SINGLE ELBOW
FINGER	F1	FIRST FINGER
	F2	BOTH FIRST FINGERS
	F3	SECOND FINGER
	F4	BOTH SECOND FINGERS
	F5	THIRD FINGER
	F6	BOTH THIRD FINGERS
	F7	FOURTH FINGER
	F8	BOTH FOURTH FINGERS
TOE	G1	GREAT TOE
	G2	BOTH GREAT TOES
	G3	TOE OTHER
	G4	TOES OTHER
HEAD, EXTERNAL	H1	EYE EXTERNAL
	H2	BOTH EYES EXTERNAL
	H3	EAR EXTERNAL
	H4	BOTH EARS EXTERNAL
	HC	CHIN
	HF	FACE
	HK	NECK/THROAT
	HM	MOUTH/LIPS
	HN	NOSE
	HS	SCALP
KNEE	KB	BOTH KNEES
	KS	KNEE
LEG, HIP, ANKLE, BUTTOCK	LB	BOTH LEGS/HIPS/ ANKLES/BUTTOCKS
	LS	SINGLE LEG/HIP ANKLE/BUTTOCK
HAND	MB	BOTH HANDS
	MS	SINGLE HAND
FOOT	PB	BOTH FEET
	PS	SINGLE FOOT
TRUNK, BONES	R1	SINGLE COLLAR BONE
	R2	BOTH COLLAR BONES
	R3	SHOULDER BLADE
	R4	BOTH SHOULDER BLADES
	RB	RIB
	RS	STERNUM (BREAST BONE)
	RV	VERTEBRAE (SPINE; DISC)
	RZ	TRUNK BONES OTHER
SHOULDER	SB	BOTH SHOULDERS
	SS	SINGLE SHOULDER
THUMB	TB	BOTH THUMBS
	TS	SINGLE THUMB
TRUNK, INTERNAL ORGANS	V1	LUNG, SINGLE
	V2	LUNGS, BOTH
	V3	KIDNEY, SINGLE
	V4	KIDNEYS, BOTH
	VH	HEART
	VL	LIVER
	VR	REPRODUCTIVE ORGANS
	VS	STOMACH
	VV	INTESTINES
	VZ	TRUNK, INTERNAL; OTHER

f. NATURE OF INJURY—Select the most appropriate nature of injury from the list below. This nature of injury shall correspond to the *primary body part* selected in 5.e. above. Enter the nature of injury name on the line and place the corresponding CODE letters identifying the nature of injury in the box provided.

* The injury or condition selected below must be caused by a specific incident or event which occurred during a single work day or shift.

GENERAL NATURE CATEGORY	CODE	NATURE OF INJURY NAME
*TRAUMATIC INJURY OR DISABILITY	TA	AMPUTATION
	TB	BACK STRAIN
	TC	CONTUSION; BRUISE; ABRASION
	TD	DISLOCATION
	TF	FRACTURE
	TH	HERNIA
	TK	CONCUSSION
	TL	LACERATION, CUT
	TP	PUNCTURE
	TS	STRAIN, MULTIPLE
	TU	BURN, SCALD, SUNBURN
	TI	TRAUMATIC SKIN DISEASES/ CONDITIONS INCLUDING DERMATITIS
	TR	TRAUMATIC RESPIRATORY DISEASE
	TQ	TRAUMATIC FOOD POISONING
	TW	TRAUMATIC TUBERCULOSIS
	TX	TRAUMATIC VIROLOGICAL/ INFECTIVE/PARASITIC DISEASE
	T1	TRAUMATIC CEREBRAL VASCULAR CONDITION/STROKE
	T2	TRAUMATIC HEARING LOSS
	T3	TRAUMATIC HEART CONDITION
	T4	TRAUMATIC MENTAL DISORDER; STRESS; NERVOUS CONDITION
	T8	TRAUMATIC INJURY — OTHER (EXCEPT DISEASE, ILLNESS)

**A nontraumatic physiological harm or loss of capacity produced by systemic infection; continued or repeated stress or strain; exposure to toxins, poisons, fumes, etc.; or other continued and repeated exposures to conditions of the work environment over a long period of time. For practical purposes, an occupational illness/disease or disability is any reported condition which doses not meet the definition of traumatic injury or disability as described above.

GENERAL NATURE CATEGORY	CODE	NATURE OF INJURY NAME
**NON-TRAUMATIC ILLNESS/DISEASE OR DISABILITY		
RESPIRATORY DISEASE	RA	ASBESTOSIS
	RB	BRONCHITIS
	RE	EMPHYSEMA
	RP	PNEUMOCONIOSIS
	RS	SILICOSIS
	R9	RESPIRATORY DISEASE, OTHER
VIROLOGICAL, INFECTIVE & PARASITIC DISEASES	VB	BRUCELLOSIS
	VC	COCCIDIOMYCOSIS
	VF	FOOD POISONING
	VH	HEPATITIS
	VM	MALARIA
	VS	STAPHYLOCOCCUS
	VT	TUBERCULOSIS
	V9	VIROLOGICAL/INFECTIVE/ PARASITIC—OTHER
DISABILITY, OCCUPATIONAL	DA	ARTHRITIS, BURSITIS
	DB	BACK STRAIN, BACK SPRAIN
	DC	CEREBRAL VASCULAR CONDITION; STROKE
	DD	ENDEMIC DISEASE (OTHER THAN CODE TYPES R&S)
	DE	EFFECT OF ENVIRONMENTAL CONDITION
	DH	HEARING LOSS
	DK	HEART CONDITION
	DM	MENTAL DISORDER, EMOTIONAL STRESS NERVOUS CONDITION
	DR	RADIATION
	DS	STRAIN, MULTIPLE
	DU	ULCER
	DV	OTHER VASCULAR CONDITIONS
	D9	DISABILITY, OTHER
SKIN DISEASE OR CONDITION	SB	BIOLOGICAL
	SC	CHEMICAL
	S9	DERMATITIS, UNCLASSIFIED

g. TYPE AND SOURCE OF INJURY (CAUSE)—Type and Source Codes are used to describe what caused the incident. The Type Code stands for an ACTION and the Source Code for an OBJECT or SUBSTANCE. Together, they form a brief description of how the incident occurred. Where there are two different sources, code the *initiating* source of the incident (see example 1, below). Examples:

(1) An employee tripped on carpet and struck his head on a desk.
TYPE: 210 (Fell on Same Level) SOURCE: 0110 (walking/ working surface)

NOTE: This example would NOT be coded 120 (struck against) and 0140 (furniture).

(2) *A Park Ranger contracted dermatitis from contact with poison ivy/ oak.*
TYPE: 510 (contact) SOURCE: 0920 (plant)

(3) A lock and dam mechanic punctured his finger with a metal sliver while grinding a turbine blade.
TYPE: 410 (punctured by) SOURCE: 0830 (metal)

(4) An employee was driving a government vehicle when it was struck by another vehicle.
TYPE: 800 (traveling in) SOURCE: 0421 (government owned vehicle, as driver)

NOTE: The Type Code 800, "Traveling In" is different from the other type codes in that its function is not to identify factors contributing to the injury or fatality, but rather to collect data on the type of vehicle the employee was operating or traveling in at the time of the incident.

Select the most appropriate TYPE and SOURCE identifier from the list below and enter the name on the line and the corresponding code in the appropriate box.

CODE	TYPE OF INJURY NAME
	STRUCK
0110	STRUCK BY
0111	STRUCK BY FALLING OBJECT
0120	STRUCK AGAINST
	FELL, SLIPPED, TRIPPED
0210	FELL ON SAME LEVEL
0220	FELL ON DIFFERENT LEVEL
0230	SLIPPED, TRIPPED (NO FALL)
	CAUGHT
0310	CAUGHT ON
0320	CAUGHT IN
0330	CAUGHT BETWEEN
	PUNCTURED, LACERATED
0410	PUNCTURED BY
0420	CUT BY
0430	STUNG BY
0440	BITTEN BY
	CONTACTED
0510	CONTACTED WITH (INJURED PERSON MOVING)
0520	CONTACTED BY (OBJECT WAS MOVING)
	EXERTED
0610	LIFTED, STRAINED BY (SINGLE ACTION)
0620	STRESSED BY (REPEATED ACTION)
	EXPOSED
0710	INHALED
0720	INGESTED
0730	ABSORBED
0740	EXPOSED TO
0800	TRAVELING IN

CODE	SOURCE OF INJURY NAME
0100	BUILDING OR WORKING AREA
0110	WALKING/WORKING SURFACE (FLOOR, STREET, SIDEWALKS, ETC)
0120	STAIRS, STEPS
0130	LADDER
0140	FURNITURE, FURNISHINGS, OFFICE EQUIPMENT
0150	BOILER, PRESSURE VESSEL
0160	EQUIPMENT LAYOUT (ERGONOMIC)
0170	WINDOWS, DOORS
0180	ELECTRICITY

CODE	SOURCE OF INJURY NAME
0200	ENVIRONMENTAL CONDITION
0210	TEMPERATURE EXTREME (INDOOR)
0220	WEATHER (ICE, RAIN, HEAT, ETC.)
0230	FIRE, FLAME, SMOKE (NOT TOBACCO)
0240	NOISE
0250	RADIATION
0260	LIGHT
0270	VENTILATION
0271	TOBACCO SMOKE
0280	STRESS (EMOTIONAL)
0290	CONFINED SPACE
0300	MACHINE OR TOOL
0310	HAND TOOL (POWERED: SAW, GRINDER, ETC.)
0320	HAND TOOL (NONPOWERED)
0330	MECHANICAL POWER TRANSMISSION APPARATUS
0340	GUARD, SHIELD (FIXED, MOVEABLE, INTERLOCK)
0350	VIDEO DISPLAY TERMINAL
0360	PUMP, COMPRESSOR, AIR PRESSURE TOOL
0370	HEATING EQUIPMENT
0380	WELDING EQUIPMENT
0400	VEHICLE
0411	AS DRIVER OF PRIVATELY OWNED/RENTAL VEHICLE
0412	AS PASSENGER OF PRIVATELY OWNED/RENTAL VEHICLE
0421	DRIVER OF GOVERNMENT VEHICLE
0422	PASSENGER OF GOVERNMENT VEHICLE
0430	COMMON CARRIER (AIRLINE, BUS, ETC.)
0440	AIRCRAFT (NOT COMMERCIAL)
0450	BOAT, SHIP, BARGE
0500	MATERIAL HANDLING EQUIPMENT
0510	EARTHMOVER (TRACTOR, BACKHOE, ETC.)
0520	CONVEYOR (FOR MATERIAL AND EQUIPMENT)
0530	ELEVATOR, ESCALATOR, PERSONNEL HOIST
0540	HOIST, SLING CHAIN, JACK
0550	CRANE
0551	FORKLIFT
0560	HANDTRUCK, DOLLY
0600	DUST, VAPOR, ETC.
0610	DUST (SILICA, COAL, ETC.)
0620	FIBERS
0621	ASBESTOS
0630	GASES
0631	CARBON MONOXIDE
0640	MIST, STEAM, VAPOR, FUME
0641	WELDING FUMES
0650	PARTICLES (UNIDENTIFIED)
0700	CHEMICAL, PLASTIC, ETC.
0711	DRY CHEMICAL—CORROSIVE
0712	DRY CHEMICAL—TOXIC
0713	DRY CHEMICAL—EXPLOSIVE
0714	DRY CHEMICAL—FLAMMABLE
0721	LIQUID CHEMICAL—CORROSIVE
0722	LIQUID CHEMICAL—TOXIC
0723	LIQUID CHEMICAL—EXPLOSIVE
0724	LIQUID CHEMICAL—FLAMMABLE
0730	PLASTIC
0740	WATER
0750	MEDICINE
0800	INANIMATE OBJECT
0810	BOX, BARREL, ETC.
0820	PAPER
0830	METAL ITEM, MINERAL
0831	NEEDLE
0840	GLASS
0850	SCRAP, TRASH
0860	WOOD
0870	FOOD
0880	CLOTHING, APPAREL, SHOES
0900	ANIMATE OBJECT
0911	DOG
0912	OTHER ANIMAL
0920	PLANT
0930	INSECT
0940	HUMAN (VIOLENCE)
0950	HUMAN (COMMUNICABLE DISEASE)
0960	BACTERIA, VIRUS (NOT HUMAN CONTACT)

CODE	SOURCE OF INJURY NAME
1000	PERSONAL PROTECTIVE EQUIPMENT
1010	PROTECTIVE CLOTHING, SHOES, GLASSES, GOGGLES
1020	RESPIRATOR, MASK
1021	DIVING EQUIPMENT
1030	SAFETY BELT, HARNESS
1040	PARACHUTE

INSTRUCTIONS FOR SECTION 6 — PUBLIC FATALITY

a. ACTIVITY AT TIME OF ACCIDENT—Select the activity being performed at the time of the accident from the list below. Enter the activity name on the line and the corresponding number in the box. If the activity performed is not identified on the list, select from the *most* appropriate primary activity area (water related, non-water related or other activity), the code number for "Other", and write in the activity being performed at the time of the accident.

WATER RELATED RECREATION

1. Sailing
2. Boating—powered
3. Boating—unpowered
4. Water skiing
5. Fishing from boat
6. Fishing from bank dock or pier
7. Fishing while wading
8. Swimming/supervised area
9. Swimming/designated area
10. Swimming/other area
11. Underwater activities (skin diving, scuba, etc.)
12. Wading
13. Attempted rescue
14. Hunting from boat
15. Other

NON-WATER RELATED RECREATION

16. Hiking and walking
17. Climbing (general)
18. Camping/picnicking authorized area
19. Camping/picnicking unauthorized area
20. Guided tours
21. Hunting
22. Playground equipment
23. Sports/summer (baseball, football, etc.)
24. Sports/winter (skiing, sledding, snowmobiling etc.)
25. Cycling (bicycle, motorcycle, scooter)
26. Gliding
27. Parachuting
28. Other non-water related

OTHER ACTIVITIES

29. Unlawful acts (fights, riots, vandalism, etc.)
30. Food preparation/serving
31. Food consumption
32. Housekeeping
33. Sleeping
34. Pedestrian struck by vehicle
35. Pedestrian other acts
36. Suicide
37. "Other" activities

b. PERSONAL FLOTATION DEVICE USED—If fatality was water-related was the victim wearing a person flotation device? Mark the appropriate box.

INSTRUCTIONS FOR SECTION 7—MOTOR VEHICLE ACCIDENT

a. TYPE OF VEHICLE—Mark appropriate box for each vehicle involved. If more than one vehicle of the same type is involved, mark both halves of the appropriate box. USACE vehicle(s) involved shall be marked in left half of appropriate box.

b. TYPE OF COLLISION—Mark appropriate box.

c. SEAT BELT—Mark appropriate box.

INSTRUCTIONS FOR SECTION 8—PROPERTY/ MATERIAL INVOLVED

a. NAME OF ITEM—Describe all property involved in accident. Property/material involved means material which is damaged or whose use or misuse contributed to the accident. Include the name, type, model; also include the National Stock Number (NSN) whenever applicable.

b. OWNERSHIP—Enter ownership for each item listed. (Enter one of the following: *USACE; OTHER GOVERNMENT; CONTRACTOR: PRIVATE)*

c. $ AMOUNT OF DAMAGE—Enter the total estimated dollar amount of damage (parts and labor), if any.

INSTRUCTIONS FOR SECTION 9—VESSEL/ FLOATING PLANT ACCIDENT

a. TYPE OF VESSEL/FLOATING PLANT—Select the most appropriate vessel/floating plant from list below. Enter name and place corresponding number in box. If item is not listed below, enter item number for "OTHER" and write in specific type of vessel/ floating plant.

VESSEL/FLOATING PLANTS

1. ROW BOAT
2. SAIL BOAT
3. MOTOR BOAT
4. BARGE
5. DREDGE/HOPPER
6. DREDGE/SIDE CASTING
7. DREDGE/DIPPER
8. DREDGE/CLAMSHELL BUCKET
9. DREDGE/PIPE LINE
10. DREDGE/DUST PAN
11. TUG BOAT
12. OTHER

b. COLLISION/MISHAP—Select from the list below the object(s) that contributed to the accident or were damaged in the accident.

COLLISION/MISHAP

1. COLLISION W/OTHER VESSEL
2. UPPER GUIDE WALL
3. UPPER LOCK GATES
4. LOCK WALL
5. LOWER LOCK GATES
6. LOWER GUIDE WALL
7. HAULAGE UNIT
8. BREAKING TOW
9. TOW BREAKING UP
10. SWEPT DOWN ON DAM
11. BUOY/DOLPHIN/CELL
12. WHARF OR DOCK
13. OTHER

INSTRUCTIONS FOR SECTION 10—ACCIDENT DESCRIPTION

DESCRIBE ACCIDENT—Fully describe the accident. Give the sequence of events that describe what happened leading up to and including the accident. Fully identify personnel and equipment involved and their role(s) in the accident. Ensure that relationships between personnel and equipment are clearly specified. Continue on blank sheets if necessary and attach to this report.

INSTRUCTIONS FOR SECTION 11—CAUSAL FACTORS

a. Review thoroughly. Answer each question by marking the appropriate block. If any answer is yes, explain in item 13 below. Consider, as a minimum, the following:

(1) DESIGN—Did inadequacies associated with the building or work site play a role? Would an improved design or layout of the equipment or facilities reduce the likelihood of similar accidents? Were the tools or other equipment designed and intended for the task at hand?

(2) INSPECTION/MAINTENANCE—Did inadequately or improperly maintained equipment, tools, workplace, etc. create or worsen any hazards that contributed to the accident? Would better equipment, facility, work site or work activity inspections *have helped avoid the accident?*

(3) PERSON'S PHYSICAL CONDITION—Do you feel that the accident would probably not have occurred if the employee was in "good" physical condition? If the person involved in the accident had been in better physical condition, would the accident have been less severe or avoided altogether? Was over exertion a factor?

(4) OPERATING PROCEDURES—Did a lack of or inadequacy within established operating procedures contribute to the accident? Did any aspect of the procedures introduce any hazard to, or increase the risk associated with the work process? Would establishment or improvement of operating procedures reduce the likelihood of similar accidents?

(5) JOB PRACTICES—Were any of the provisions of the Safety and Health Requirements Manual (EM 385-1-1) violated? Was the task being accomplished in a manner which was not in compliance with an established job hazard analysis or activity hazard analysis? Did any established job practice (including EM 385-1-1) fail to adequately address the task or work process? Would better job practices improve the safety of the task?

(6) HUMAN FACTORS—Was the person under undue stress (either internal or external to the job)? Did the task tend toward *overloading the capabilities of the person; i.e., did the job* require tracking and reacting to many external inputs such as displays, alarms, or signals? Did the arrangement of the workplace tend to interfere with efficient task performance? Did the task require reach, strength, endurance, agility, etc., at or beyond the capabilities of the employee? Was the work environment ill-adapted to the person? Did the person need more training, experience, or practice in doing the task? Was the person inadequately rested to perform safely?

(7) ENVIRONMENTAL FACTORS—Did any factors such as moisture, humidity, rain, snow, sleet, hail, ice, fog, cold, heat, sun, temperature changes, wind, tides, floods, currents, dust, mud, glare, pressure changes, lightning, etc., play a part in the accident?

(8) CHEMICAL AND PHYSICAL AGENT FACTORS—Did exposure to chemical agents (either single shift exposure or long-term exposure) such as dusts, fibers (asbestos, etc.), silica, gases (carbon monoxide, chlorine, etc.,), mists, steam, vapors, fumes, smoke, other particulates, liquid or dry chemicals that are corrosive, toxic, explosive or flammable, by-products of combustion or physical agents such as noise, ionizing radiation, non-ionizing radiation (UV radiation created during welding, etc.) contribute to the accident/incident?

(9) OFFICE FACTORS—Did the fact that the accident occurred in an office setting or to an office worker have a bearing on its cause? For example, office workers tend to have less experience and training in performing tasks such as lifting *office furniture. Did physical hazards within the office* environment contribute to the hazard?

(10) SUPPORT FACTORS—Was the person using an improper tool for the job? Was inadequate time available or utilized to safely accomplish the task? Were less than adequate personnel resources (in terms of employee skills, number of workers, and adequate supervision) available to get the job done properly? Was funding available, utilized, and adequate to provide proper tools, equipment, personnel, site preparation, etc?

(11) PERSONAL PROTECTIVE EQUIPMENT—Did the person fail to use appropriate personal protective equipment (gloves, eye protection, hard-toed shoes, respirator, etc.) for the task or *environment? Did protective equipment provided or worn fail to* provide adequate protection from the hazard(s)? Did lack of or inadequate maintenance of protective gear contribute to the accident?

(12) DRUGS/ALCOHOL—Is there any reason to believe the person's mental or physical capabilities, judgement, etc., were impaired or altered by the use of drugs or alcohol? Consider the effects of prescription medicine and over the counter medications as well as illicit drug use. Consider the effect of drug or alcohol induced "hangovers".

b. WRITTEN JOB/ACTIVITY HAZARD ANALYSIS—Was a written Job/Activity Hazard Analysis completed for the task being *performed at the time of the accident? Mark the appropriate box. If one was performed, attach a copy of the analysis to the report.*

INSTRUCTIONS FOR SECTION 12—TRAINING

a. WAS PERSON TRAINED TO PERFORM ACTIVITY/TASK?—For the purpose of this section "trained" means the person has been provided the necessary information (either formal and/or on-the-job (OJT) training) to competently perform the activity/task in a safe and healthful manner.

b. TYPE OF TRAINING—Mark the appropriate box that best indicates the type of training; (classroom or on-the-job) that the injured person received before the accident happened.

c. DATE OF MOST RECENT TRAINING—Enter the month, day, and year of the last *formal* training completed that covered the activity-task being performed at the time of the accident.

INSTRUCTIONS FOR SECTION 13—CAUSES

a. DIRECT CAUSES—The direct cause is that single factor which most directly lead to the accident. See examples below.

b. INDIRECT CAUSES—Indirect causes are those factors which contributed to but did not directly initiate the occurrence of the accident.

Examples for section 13:

a. Employee was dismantling scaffold and fell 12 feet from unguarded opening.
Direct cause: failure to provide fall protection at elevation.
Indirect causes: failure to enforce USACE safety requirements; improper training/motivation of employee (possibility that employee was not knowledgeable of USACE fall protection requirements or was lax in his attitude towards safety); failure to ensure provision of positive fall protection whenever elevated; failure to address fall protection during scaffold dismantling in phase hazard analysis.

b. Private citizen had stopped his vehicle at intersection for red light when vehicle was struck in rear by USACE vehicle. (note USACE vehicle was in proper/safe working condition).
Direct cause: failure of USACE driver to maintain control of and stop USACE vehicle within safe distance.
Indirect cause: Failure of employee to pay attention to driving (defensive driving).

INSTRUCTIONS FOR SECTION 14—ACTION TO ELIMINATE CAUSE(S)

DESCRIPTION—Fully describe all the actions taken, anticipated, and recommended to eliminate the cause(s) and prevent reoccurrence of similar accidents/illnesses. Continue on blank sheets of paper if necessary to fully explain and attach to the completed report form.

INSTRUCTIONS FOR SECTION 15—DATES FOR ACTION

a. BEGIN DATE—Enter the date when the corrective action(s) identified in Section 14 will begin.

b. COMPLETE DATE—Enter the date when the corrective action(s) identified in Section 14 will be completed.

c. TITLE AND SIGNATURE—Enter the title and signature of supervisor completing the accident report. For a GOVERNMENT employee accident/illness the immediate supervisor will complete and sign the report. For PUBLIC accidents the USACE Project Manager/Area Engineer responsible for the USACE property where the accident happened shall complete and sign the report. For CONTRACTOR accidents the Contractor's project manager shall complete and sign the report and provide to the USACE supervisor responsible for oversight of that contractor activity. This USACE Supervisor shall also sign the report. Upon entering the information required in 15.d, 15.e and 15.f below, the responsible USACE supervisor shall forward the report for management review as indicated in Section 16.

d. DATE SIGNED—Enter the month, day, and year that the report was signed by the responsible supervisor.

e. ORGANIZATION NAME—For GOVERNMENT employee accidents enter the USACE organization name (Division, Branch, Section, etc.) of the injured employee. For PUBLIC accidents enter the USACE organization name for the person identified in block 15.c. For CONTRACTOR accidents enter the USACE organization name for the USACE office responsible for providing contract administration oversight.

f. OFFICE SYMBOL—Enter the latest complete USACE Office Symbol for the USACE organization identified in block 15.e.

INSTRUCTIONS FOR SECTION 16—MANAGEMENT REVIEW (1st)

1ST REVIEW—Each USACE FOA shall determine who will provide 1st management review. The responsible USACE supervisor in section 15.c shall forward the completed report to the USACE office designated as the 1st Reviewer by the FOA. Upon receipt, the Chief of the Office shall review the completed report, mark the appropriate box, provide substantive comments, sign, date, and forward to the FOA Staff Chief (2nd review) for review and comment.

INSTRUCTIONS FOR SECTION 17—MANAGEMENT REVIEW (2nd)

2ND REVIEW—The FOA Staff Chief (i.e., FOA Chief of Construction, Operations, Engineering, Planning, etc.) shall mark the appropriate box, review the completed report, provide substantive comments, sign, date, and return to the FOA Safety and Occupational Health Office.

INSTRUCTIONS FOR SECTION 18—SAFETY AND OCCUPATIONAL HEALTH REVIEW

3RD REVIEW—The FOA Safety and Occupational Health Office shall review the completed report, mark the appropriate box, ensure that any inadequacies, discrepancies, etc, are rectified by the responsible supervisor and management reviewers, provide substantive comments, sign, date and forward to the FOA Commander for review, comment, and signature.

INSTRUCTION FOR SECTION 19—COMMAND APPROVAL

4TH REVIEW—The FOA Commander shall (to include the person designated Acting Commander in his absence) review the completed report, comment if required, sign, date, and forward the report to the FOA Safety and Occupational Health Office. Signature authority shall not be delegated.

Appendix H
Decontamination

APPENDIX H DECONTAMINATION

H.1 GENERAL

Personnel involved with hazardous material handling may be exposed to compounds in a number of ways, despite the most stringent protective procedures. Personnel may come in contact with vapors, gases, mists, or particulates in the air, or may come in contact with site media while performing work tasks. Use of monitoring instruments and equipment can also result in exposure to hazardous substances.

In general, decontamination involves scrubbing with a non-phosphate soap/water solution followed by clean water rinses. All disposable items will be disposed of in a dry container. Certain parts of contaminated respirators, such as harness assemblies and leather or cloth components, are difficult to decontaminate. If grossly contaminated, they may have to be discarded. Rubber components can be soaked in soap and water and scrubbed with a brush. In addition to being decontaminated, all respirators, non-disposable protective clothing, and other personal articles must be sanitized before they can be used again unless they are assigned to individuals. The manufacturer's instructions should be followed in sanitizing the respirator masks. The Site Safety Officer or his qualified designee will be responsible for supervising the proper decontamination of protective equipment.

H.2 STANDARD PPE DECONTAMINATION

The Site Safety Officer or his qualified designee will monitor decontamination procedures to ensure their effectiveness. Modifications of the decontamination procedure may be necessary as determined by the Site Safety Officer or his designee.

Level D Personal Protection Decontamination Procedure

Step 1 - Boot Cover and Glove Wash (if applicable)

Scrub outer boot covers and gloves with decon solution or detergent and water.

Step 2 - Boot Cover and Glove Rinse (if applicable)

Rinse off decon solution from Step 1 using copious amounts of water.

Step 3 - Boot Cover Removal (if applicable)

Remove boot covers and deposit in container with plastic liner.

Step 4 - Glove Removal (if applicable)

Remove gloves and deposit in container with plastic liner.

Step 5 - Field Wash

Wash hands and face with soap and water.